THE MARINE REVIEW

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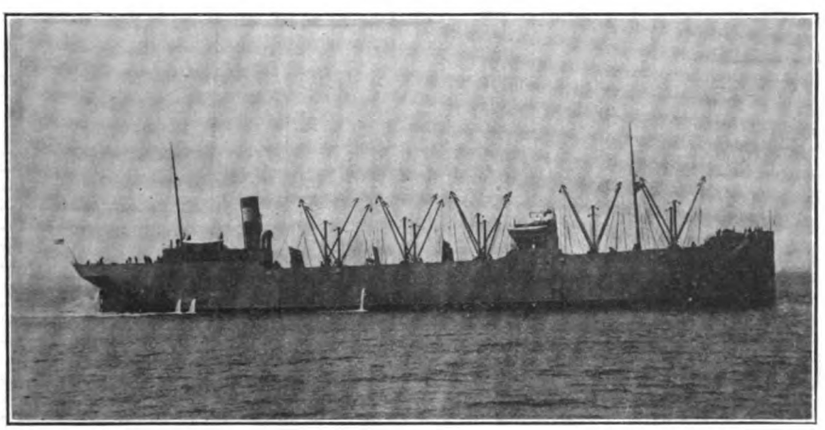
Fleet Colliers Mars, Vulcan and Hector

THE September number of the REVIEW contained a description of the fleet colliers Vestal and Prometheus building in the New York and Mare Island navy yards. We are fortunate this month in being able to present an even more complete description of the fleet colliers Mars, Vulcan and Hector, built by the Maryland Steel Co., Sparrows Point, Md. The Hector, last



U. S. FLEET COLLIERS MARS, VULCAN AND HECTOR. BUILT BY MARYLAND STEEL CO.

of the three, completed her contract trials last month and with results equally as creditable as her sister ships. Especial interest attaches to these ships entirely apart from the features of their design.

They were built under the act of May 13, 1908, authorizing the purchase of three colliers, the exact wording of the act being as follows:

"The Secretary of the Navy, in his discretion, is hereby authorized *to purchase* three new steam colliers of American registry, having a cargo carrying capacity of approximately 7,200 tons dead weight each, at a cost not exceeding $525,000 each; and the sum of $1,575,000 is hereby appropriated, out of any money in the Treasury not otherwise appropriated, for the purchase of the colliers above authorized."

As no ships acceptable to the Department were offered, a circular was prepared soliciting bids on three ships to comply with certain requirements of the Department but to be to bidder's own design and under standard specification rules, and which the Department bound itself to purchase on completion of satisfactory trials if otherwise in conformity with the specifications. The circular contained the following proviso:—

"It is to be distinctly understood that the vessels must be constructed complete at the bidder's own risk and expense, and that no payment whatever will be made on any vessel by the Government until its completion and successful trial by the Navy Department, when, upon approval by the secretary of the navy, the whole price will be due and payable, except a reservation of 5 per cent to cover a six months' guarantee against defects; such reservation, less cost of making good defects, to be payable at the expiration of six months after delivery."

As to delivery the circular stipulated:

"The maximum time allowed for completion and beginning of trial trip will be limited by the Department to 12 months for one vessel, and not more than one month more for each additional vessel after the first awarded to the same bidder; and no bids will be considered which propose to exceed these limits."

The trials provided for consisted of a 24-hour run at full speed, loaded, at not less than 12 knots. Although coal consumption was to be determined during trials, there was no stipulated limit in the specifications.

General Description of Vessel.

The circular specifications called for a single deck collier with forecastle, bridge, and poop, with double bottom ballast tanks and upper wing ballast tanks formed in the triangular space between the deck and the side outboard of the cargo hatches, or other equivalent type of carrying arrangements which will prevent undue stiffness when the vessel is empty in ballast. To have a continuous sea speed of 12 knots loaded with 7,200 tons of cargo coal, 300 tons of bunker coal, 50 tons of reserve feed water, 20 tons of drinking water, 50 tons for stores and crew. With the above load the mean draught must not exceed 24 ft. 6 in., and the free

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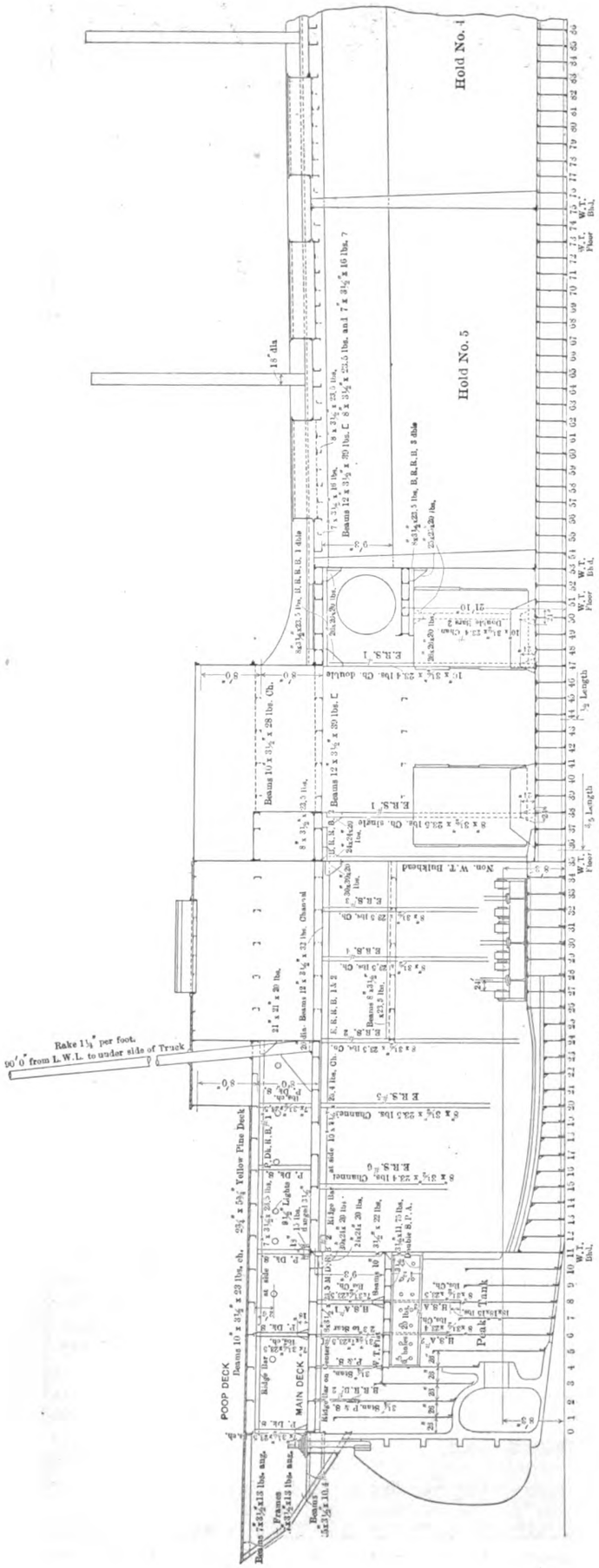
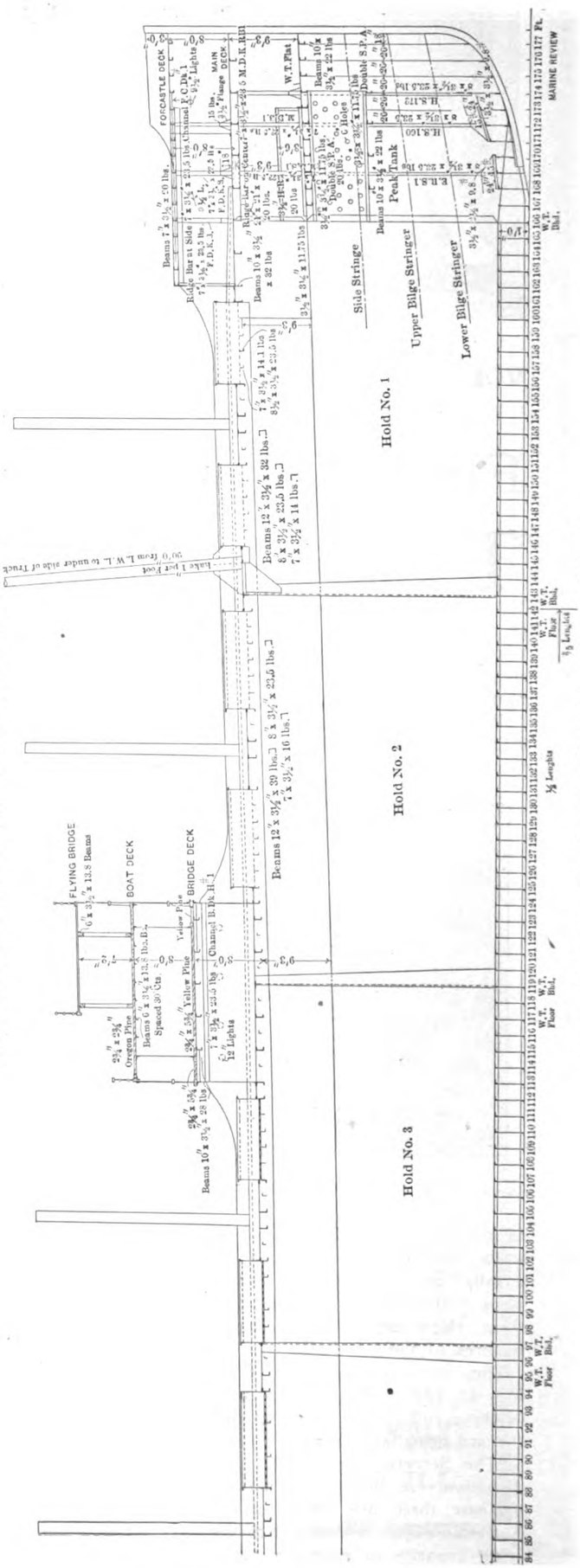


After Longitudinal Section, Mars, Vulcan and Hector.



Forward Longitudinal Section, Mars, Vulcan and Hector.

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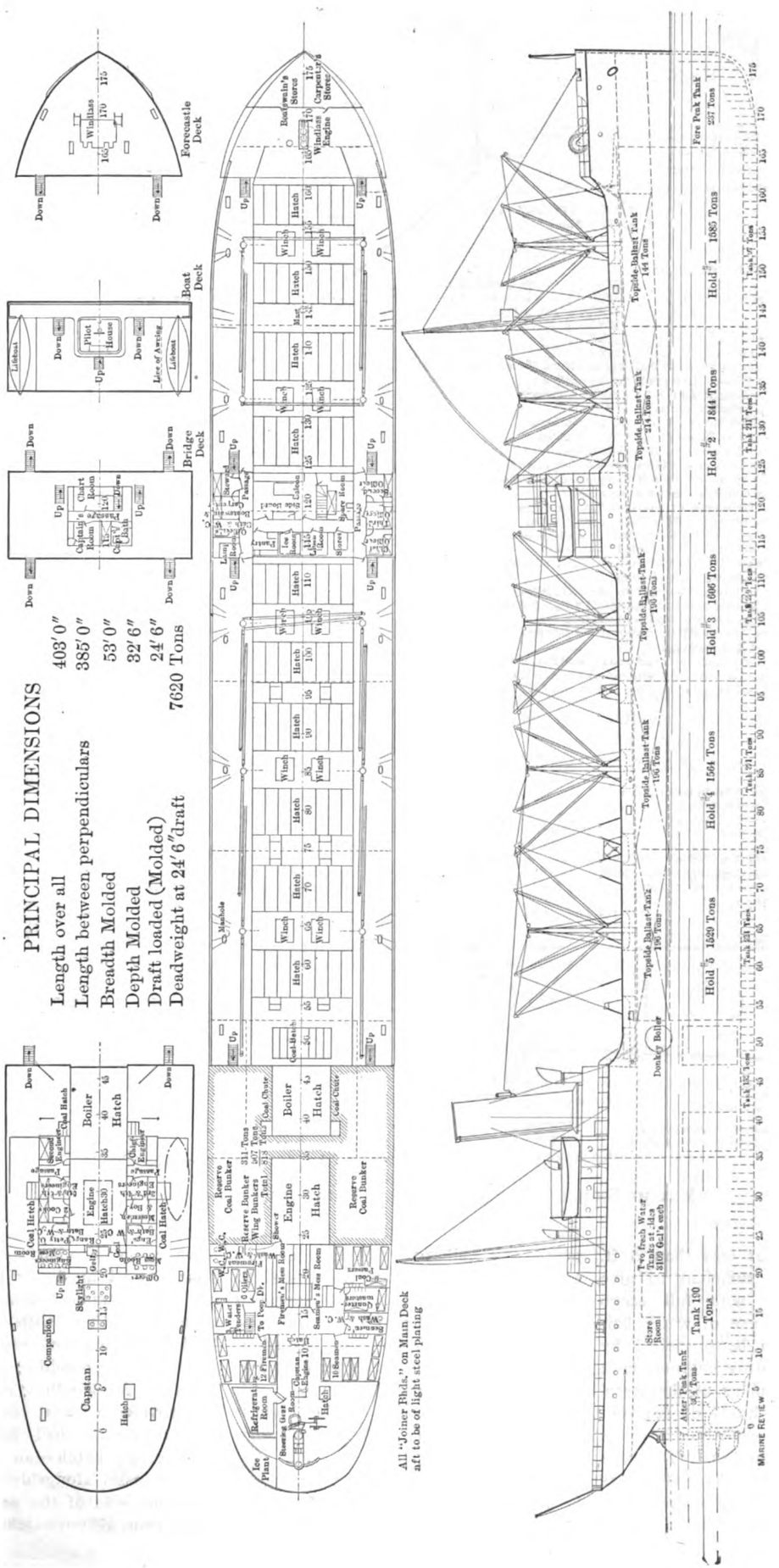

PROFILE AND DECK PLANS, U. S. FLEET COLLIERS MARS, VULCAN AND HECTOR.

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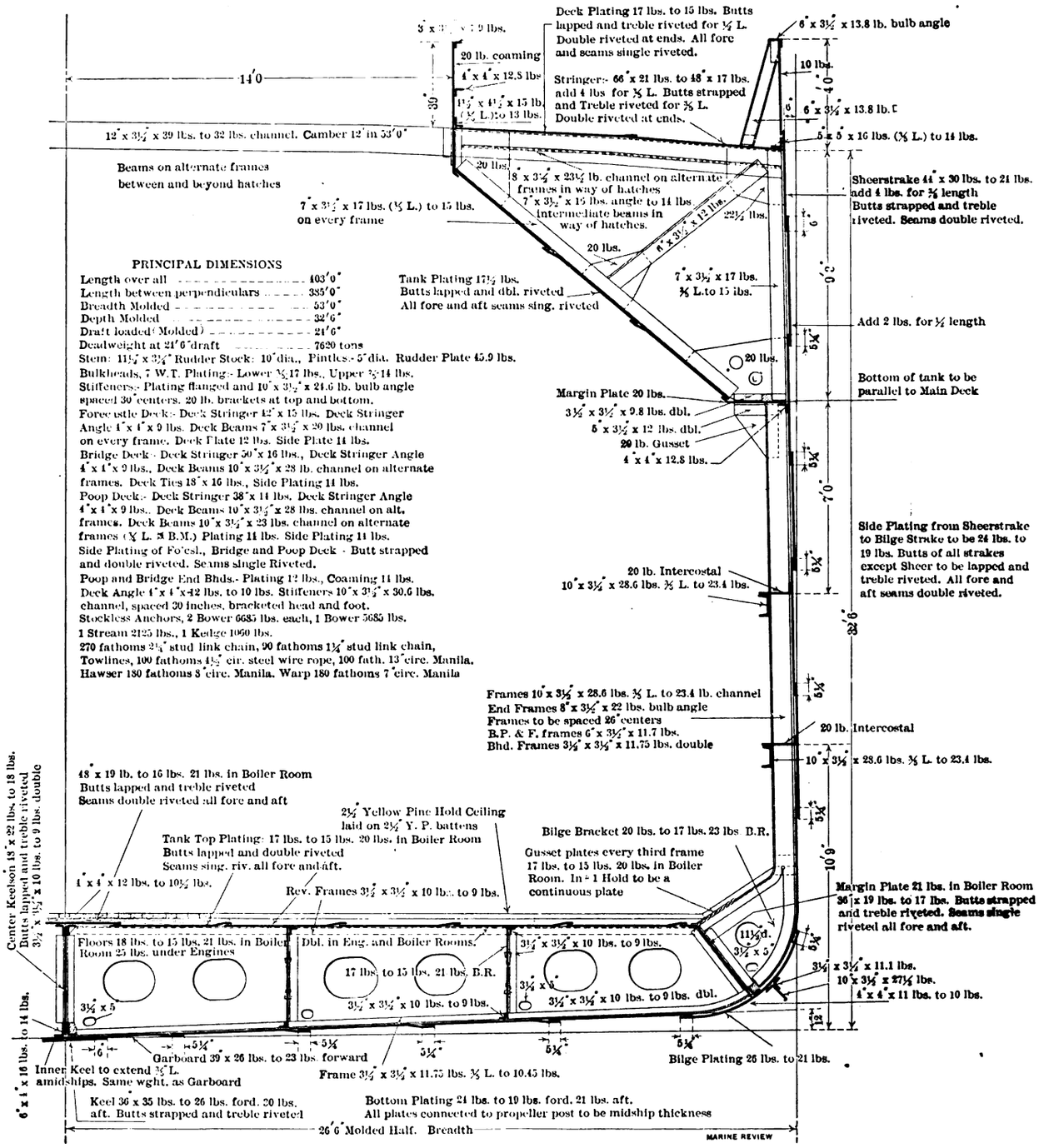
PRINCIPAL DIMENSIONS
Length over all ... 403'0"
Length between perpendiculars ... 385'0"
Breadth Molded ... 53'0"
Depth Molded ... 32'6"
Draft loaded (Molded) ... 24'6"
Deadweight at 24'6" draft ... 7620 tons
Stem: 11½" x 3¼" Rudder Stock: 10" dia., Pintles 5" dia. Rudder Plate 45.9 lbs.
Bulkheads, T. W.T. Plating:- Lower ⅝ 17 lbs., Upper ⅝ 14 lbs.
Stiffeners:- Plating flanged and 10" x 3½" x 24.6 lb. bulb angle spaced 30" centers. 20 lb. brackets at top and bottom.
Forecastle Deck:- Deck Stringer 42" x 15 lbs. Deck Stringer Angle 4" x 4" x 9 lbs. Deck Beams 7" x 3½" x 20 lbs. channel on every frame. Deck Plate 12 lbs. Side Plate 14 lbs.
Bridge Deck:- Deck Stringer 50" x 16 lbs., Deck Stringer Angle 4" x 4" x 9 lbs., Deck Beams 10" x 3½" x 28 lb. channel on alternate frames. Deck Ties 18" x 16 lbs., Side Plating 14 lbs.
Poop Deck:- Deck Stringer 38" x 14 lbs. Deck Stringer Angle 4" x 4" x 9 lbs.. Deck Beams 10" x 3½" x 28 lbs. channel on alt. frames. Deck Beams 10" x 3½" x 23 lbs. channel on alternate frames (⅝ L. & B.M.) Plating 14 lbs. Side Plating 14 lbs.
Side Plating of Fo'csl., Bridge and Poop Deck - Butt strapped and double riveted. Seams single Riveted.
Poop and Bridge End Bhds.- Plating 12 lbs., Coaming 14 lbs.
Deck Angle 4" x 4" x 42 lbs. to 10 lbs. Stiffeners 10" x 3½" x 30.6 lbs. channel, spaced 30 inches, bracketed head and foot.
Stockless Anchors, 2 Bower 6685 lbs. each, 1 Bower 5685 lbs.
1 Stream 2125 lbs., 1 Kedge 1050 lbs.
270 fathoms 2¾" stud link chain, 90 fathoms 1¼" stud link chain, Towlines, 100 fathoms 4½" cir. steel wire rope, 100 fath. 13" cire. Manila. Hawser 180 fathoms 8" cire. Manila. Warp 180 fathoms 7" cire. Manila
Deck Plating 17 lbs. to 15 lbs. Butts lapped and treble riveted for ½ L. Double riveted at ends. All fore and seams single riveted.
Stringers:- 66" x 21 lbs. to 48" x 17 lbs. add 4 lbs for ⅝ L. Butts strapped and Treble riveted for ⅝ L. Double riveted at ends.
20 lb. coaming
4" x 4" x 12.8 lbs
11½" x 4½" x 15 lbs. (½ L.) to 13 lbs.
12" x 3½" x 39 lbs. to 32 lbs. channel. Camber 12" in 53'0"
Beams on alternate frames between and beyond hatches
7" x 3½" x 17 lbs. (½ L.) to 15 lbs. on every frame
20 lbs.
8" x 3¼" x 23½ lb. channel on alternate frames in way of hatches
7" x 3½" x 15 lbs. angle to 14 lbs. intermediate beams in way of hatches.
22½ lbs.
6" x 3½" x 13.8 lb. bulb angle
10 lbs.
6" x 3¼" x 13.8 lb.
5" x 5" x 16 lbs. (⅝ L.) to 14 lbs.
Sheerstrake 44" x 30 lbs. to 21 lbs. add 4 lbs. for ⅝ length Butts strapped and treble riveted. Seams double riveted.
Tank Plating 17½ lbs. Butts lapped and dbl. riveted All fore and aft seams sing. riveted
7" x 3½" x 17 lbs. ⅝ L. to 15 lbs.
Add 2 lbs. for ½ length
Bottom of tank to be parallel to Main Deck
Margin Plate 20 lbs.
3½" x 3½" x 9.8 lbs. dbl.
5" x 3½" x 12 lbs. dbl.
20 lb. Gusset
4" x 4" x 12.8 lbs.
Side Plating from Sheerstrake to Bilge Strake to be 24 lbs. to 19 lbs. Butts of all strakes except Sheer to be lapped and treble riveted. All fore and aft seams double riveted.
20 lb. Intercostal
10" x 3½" x 28.6 lbs. ⅝ L. to 23.4 lbs.
Frames 10" x 3½" x 28.6 lbs. ⅝ L. to 23.4 lb. channel
End Frames 8" x 3½" x 22 lbs. bulb angle
Frames to be spaced 26" centers
B.P. & F. frames 6" x 3½" x 11.7 lbs.
Bhd. Frames 3½" x 3½" x 11.75 lbs. double
20 lb. Intercostal
10" x 3½" x 28.6 lbs. ⅝ L. to 23.4 lbs.
48" x 19 lb. to 16 lbs. 21 lbs. in Boiler Room Butts lapped and treble riveted Seams double riveted all fore and aft
2½" Yellow Pine Hold Ceiling laid on 2½" Y. P. battens
Tank Top Plating: 17 lbs. to 15 lbs. 20 lbs. in Boiler Room Butts lapped and double riveted Seams sing. riv. all fore and aft.
Bilge Bracket 20 lbs. to 17 lbs. 23 lbs. B.R.
Gusset plates every third frame 17 lbs. to 15 lbs. 20 lbs. in Boiler Room. In #1 Hold to be a continuous plate
4" x 4" x 12 lbs. to 10½ lbs.
Rev. Frames 3½" x 3½" x 10 lbs. to 9 lbs.
Center Keelson 18" x 22 lbs. to 18 lbs. Butts lapped and treble riveted 3½" x 3½" x 10 lbs. to 9 lbs. double
Margin Plate 21 lbs. in Boiler Room 36" x 19 lbs. to 17 lbs. Butts strapped and treble riveted. Seams single riveted all fore and aft.
Floors 18 lbs. to 15 lbs. 21 lbs. in Boiler Room 25 lbs. under Engines
Dbl. in Eng. and Boiler Rooms.
17 lbs. to 15 lbs. 21 lbs. B.R.
3½" x 3½" x 10 lbs. to 9 lbs.
3½" x 3½" x 10 lbs. to 9 lbs. dbl.
3½" x 3½" x 11.1 lbs.
10" x 3½" x 27½ lbs.
4" x 4" x 11 lbs. to 10 lbs.
6" x 4" x 16 lbs. to 14 lbs.
Inner Keel to extend ⅜ L. amidships. Same wght. as Garboard
Garboard 39" x 26 lbs. to 23 lbs. forward
Frame 3½" x 3½" x 11.75 lbs. ⅜ L. to 10.45 lbs.
Bilge Plating 26 lbs. to 21 lbs.
Keel 36" x 35 lbs. to 26 lbs. ford. 20 lbs. aft. Butts strapped and treble riveted
Bottom Plating 24 lbs. to 19 lbs. ford. 21 lbs. aft. All plates connected to propeller post to be midship thickness
26'6" Molded Half. Breadth
MARINE REVIEW

MIDSHIP SECTION U. S. FLEET COLLIERS MARS, VULCAN AND HECTOR.

board molded be not less than 8 ft. The beam must be sufficient to give satisfactory stability with full cargo of coal without the use of water ballast. The vessel to be propelled by twin-screw, reciprocating engines, with the propulsive machinery at the stern. To have five cargo holds of approximately equal length, each hold to have two large cargo hatches. To have capacity for not less than 800 tons of bunker coal. To have at least two masts for signaling and lookout purposes, one well forward the other well aft. The scantlings of the vessel to be in accordance with and approved by one of the classification societies, the name of which is to be stated in the proposal; the structural work, fittings, joiner, and carpenter work and all details to be of the highest class usually fitted on American cargo steamers.

"Coaling Appliances.—The vessel to be provided with appliances for rapid coaling of vessels alongside or to storage on a wharf. For this purpose special masts or king posts are to be so arranged that cargo can be unloaded either with a clam shell bucket of one-ton capacity in each hatch, or for handling coal with large skips, or for handling coal in bags; to be provided with at least ten winches and ten clam shell buckets, so that each cargo hatch can be worked to coal a vessel alongside or to put coal over one side of the vessel simultaneously from all ten hatches; the winches

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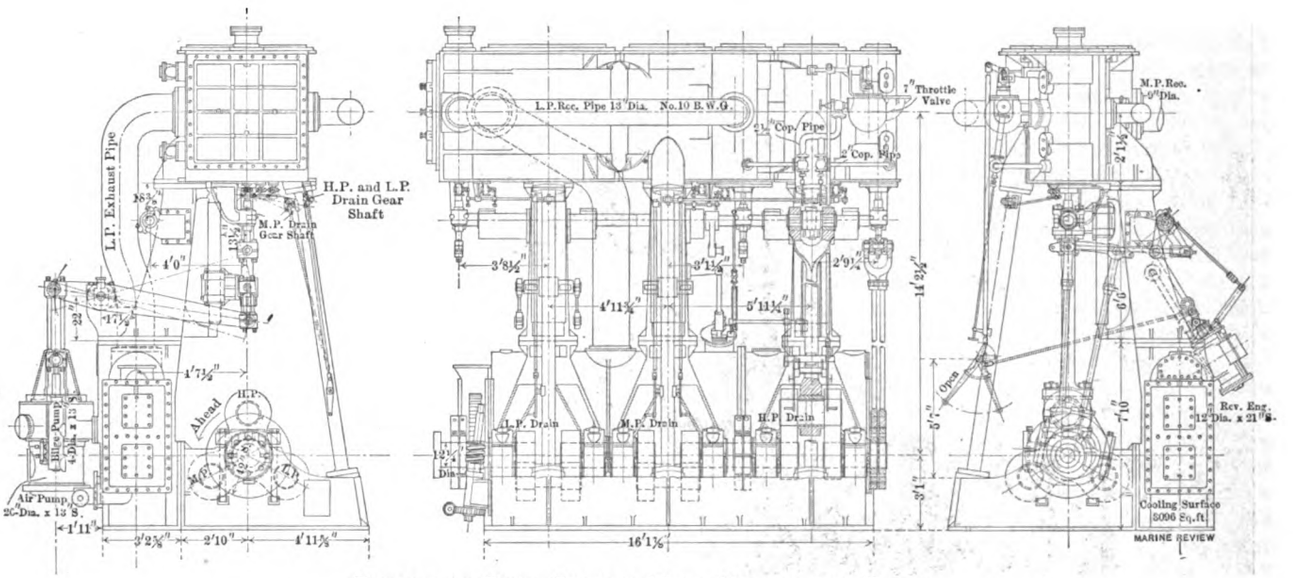
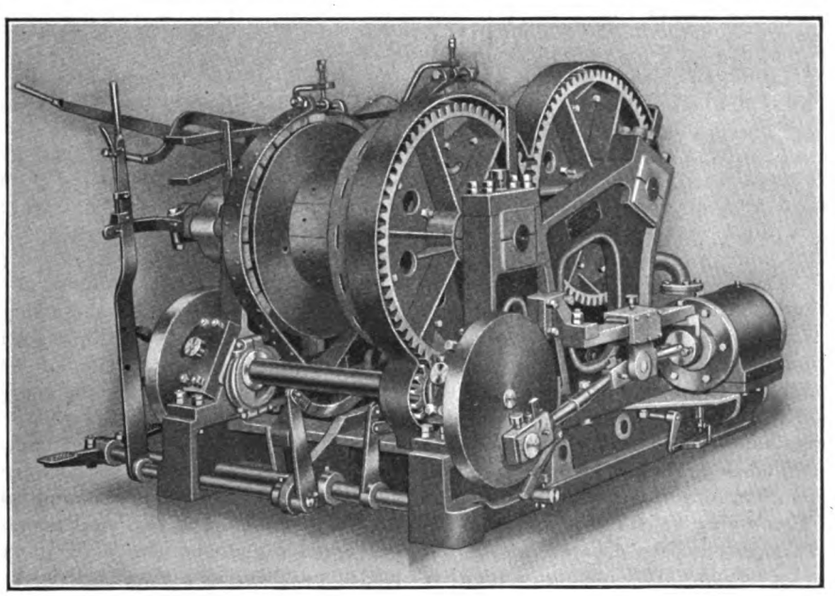


ENGINES OF FLEET COLLIERS MARS, VULCAN AND HECTOR.

to be of ample power to handle the loaded clam shell buckets, the masts or king posts and booms to be provided with all necessary standing and running rigging and gear; five one cubic yard coaling skips to be provided in addition to the clam shell buckets. Outline type sketch plan and specifications of coaling appliances con-



LIDGERWOOD DOUBLE DRUM COAL-HANDLING WINCH.

sidered satisfactory may be obtained upon application to the Bureau of Construction and Repair, but any scheme of coaling appliances and gear may be submitted by bidders in their bids and will be considered by the Department.

"Accommodations for Officers and Crew.—The vessel is to be arranged with quarters and accommodations of the character usual on a high grade cargo steamer for a merchant crew consisting of the following: 1 captain, 3 watch officers, 1 boatswain, 1 carpenter, 3 quartermasters, 10 seamen, 1 steward, 2 cooks, 1 messman, 1 cabin boy, 1 chief engineer, 5 assistant engineers, 6 oilers, 3 water tenders, 12 firemen, 9 coal passers: total 60.

Propulsive Machinery (Abstract).

"Engines.—The machinery will consist of twin screw triple expansion engines of sufficient power to drive the vessel 12 knots when loaded. The engines to be of merchant type, designed for a moderate piston speed for continuous steaming at full power.

"Boilers.—The boilers will be cylindrical, single ended, and if designed for Howden or forced heated draft must have a ratio of heating to grate surface of not less than 43 to 1, and be proportioned for not more than 16 H. P. per sq. ft. of grate. Heated ash pit draft only will be considered.

"There will be a donkey boiler of suitable size for port service, including the running of dynamo for lighting, for steam heating the vessel in cold weather, for running the windlass and capstan when changing berth and for distilling drinking water. The donkey boiler to be connected with the auxiliary steam system of the vessel and provided with all necessary fittings and pumps.

"Auxiliaries.—There will be an auxiliary condenser with the necessary pumps connected with the auxiliary exhaust system, as also one or more evaporators with suitable pumps and connections for making drinking water and for make-up purposes, and a distiller."

As to inspection it was provided that:

"The Navy Department will reserve the right to appoint visiting inspectors to examine the plans and the quality of work, but without any authority to make changes therein, and no change shall be made in the plans and specifications after they are adopted, except by mutual agreement."

It will be noted that the contractor received no payments whatever previous to the acceptance of the ship and was relieved of naval supervision and inspection and that if the ship carried the specified load at the stated speed and was granted a classification certificate the navy was bound to

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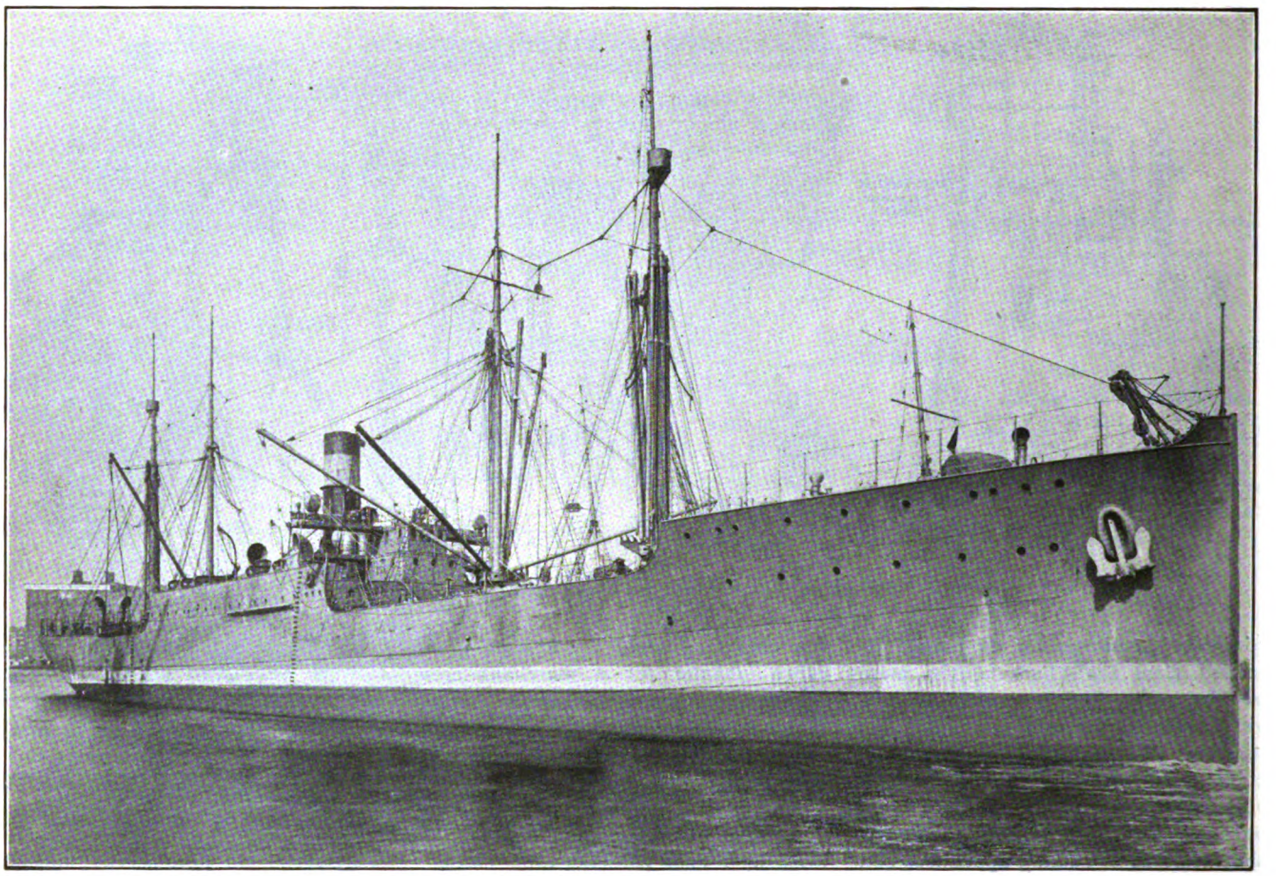

U. S. FLEET COLLIER VESTAL. BUILT AT NEW YORK NAVY YARD

accept her, all features finding place for the first time, it is believed, in a naval contract. That it is eminently the most sensible and satisfactory method cannot be doubted. The contract was awarded to the Maryland Steel Co. in Sept. 1908, at a price of $1,470,000 for the three.

As will be noted from the accompanying plans, the dimensions fixed upon in the Maryland Steel Co's designs were: Length over all, 403 ft.; between perpendiculars, 385 ft.; beam molded, 53 ft.; depth molded, 32 ft. 6 in.; draught loaded, 24 ft. 6 in.; displacement loaded, 11,220 tons; deadweight capacity on 24 ft. 6 in. draught, 7,620 tons.

As a large steaming radius was desired, a bunker capacity of 800 tons is provided, although the specified bunker capacity was only 300 tons.

The vessel, as shown in the plans, is divided into five cargo compartments, with a total capacity of 8,125 tons of coal. This amount, however, will not be reached in actual service, as 7,200 tons are all that the requirements call for. There is thus a total deadweight capacity of 1,425 tons in excess of requirements, though of course at increased draught. Aft of the cargo holds are the boiler and engine rooms. In the latter space is a large tank used for trimming the ship, or for reserve feed water. Aft of this tank is the after peak tank extending from the keel to the main deck, which is also used for trimming purposes. The inner bottom extends continuously from the forward peak bulkhead to the after end of the boiler room, and has a depth of 4 ft. throughout its length. On either side of the ship is a topside ballast tank extending from 13 ft. aft of the forward peak bulkhead to the forward end of the boiler room. These tanks in conjunction with the inner bottom and peak tanks are used for carrying ballast when ship is in a light condition.

The dining saloon, pantry and officers' quarters are located under the bridge deck. The dining saloon is paneled in quartered oak. Above same are the captain's room, bath, and chart room. Captain's room and chart room are paneled in mahogany, bath tiled. On the boat deck is the pilot house abreast of which are two 22-ft. life boats. Above the pilot house is the flying bridge, which extends to the side of the ship.

The engineer's quarters, bath, galley and mess room are located in a deck house on the poop deck, and finished in quartered oak and cypress, and the quarters for firemen, crew and quartermasters, mess rooms, etc., are between the main and poop decks. On the after end of this space are the steering engine and refrigerating plant, the latter of a capacity to cool a refrigerating room of 800 cu. ft. of volume. The refrigerating machine is driven by a Remington oil engine.

Although the contract for these ships provided that the coal handling apparatus should have a capacity of 100 tons per hour per hatch, yet the equipment has actually handled 180 tons per hour, and about it, therefore, much interest naturally centers. There are five pairs of derrick masts and on each mast are stepped two steel booms, one forward and one aft. Coal is unloaded by lowering a clam shell bucket into the hold and then hoisting, which operation fills the bucket, sufficiently to clear the hatch coaming, when the winch operator starts the outhaul rope carrying the clam shell to the head of the outboard boom clear of the ship's side, and over a wharf or the deck of an adjacent warship. By means of a trip rope controlled by a drum on the hoisting winch the bucket is opened, thereby discharging the coal. The clam shell is brought back over the hatch by the outhaul rope acting as

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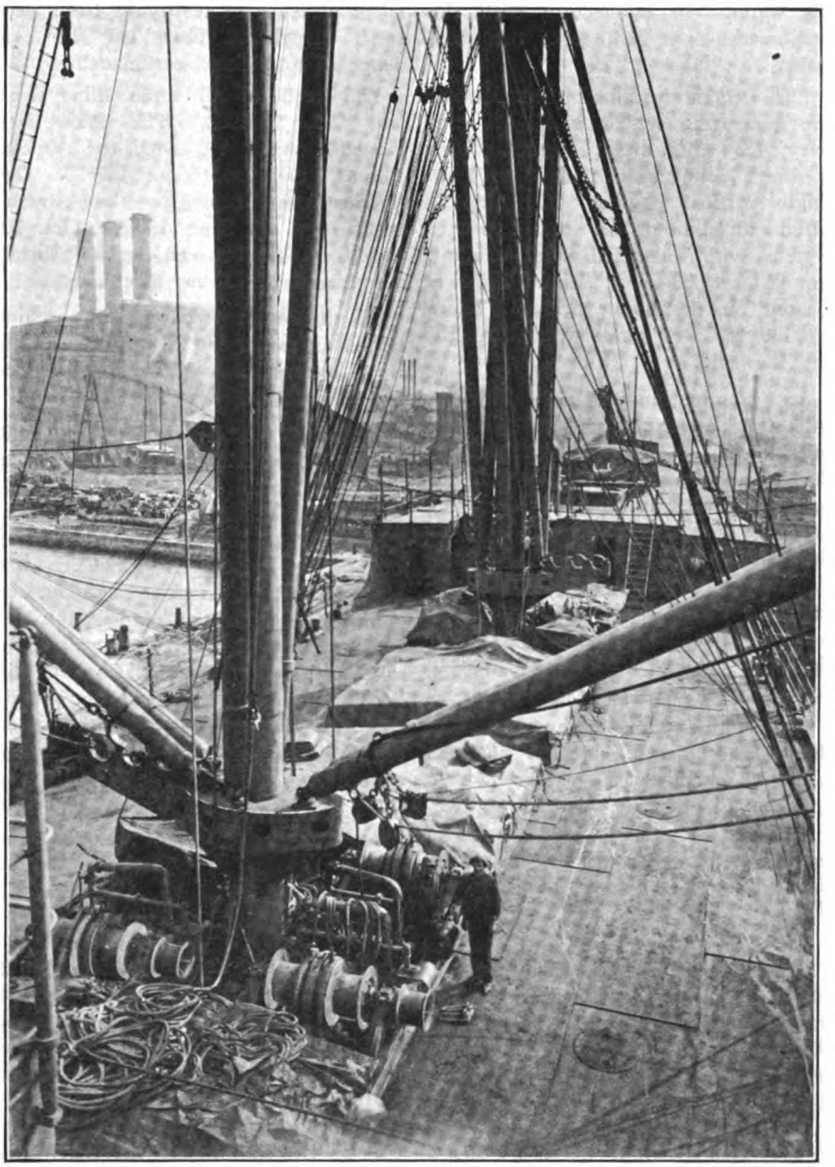

U. S. FLEET COLLIER, VESTAL. VIEW OF FORWARD DECK, SHOWING COAL-HANDLING GEAR.

an inhaul, and then lowered into the holds by the hoisting rope, when operation of unloading is repeated. For each hatch there are provided two winches, built by the Lidgerwood Mfg. Co., New York City, and shown in the accompanying illustration. For the ten hatches there are, consequently, 20 of these double-cylinder double-drum machines. The cylinders are 8¼ in. diameter by 10 in. stroke. A bronze pinion on the crank shaft engages with the forward drum gear, which in turn drives the rear drum. The drum gears are of cast steel, and both, as well as the pinion, are machine cut.

The handling of 180 tons per hour per hatch necessarily means very rapid handling of the winches, and the features which make this possible are, firstly, the type of friction employed, and secondly, the arrangement of levers. The method of operating is as follows: One winch performs the swinging or hauling out operation, the other the hoisting and lowering. The swinging winch is placed at the outboard corner of the hatch. The hoisting winch is located nearly amidships, and although practically identical in construction, the method of operation is entirely different. On the swinging winch the two drums merely take in or pay out the inhaul and outhaul ropes which sway the bucket over the side; consequently, the manipulation of the winch is merely one of rapid reversal, and the frictions are locked permanently. The hoisting winch, however, requires separate movement of the drums for hoisting and opening and closing the bucket. The operator therefore uses the two friction levers and the throttle pedals, but does not have to reverse his machine, controlling the lowering entirely by the friction. The construction of these frictions is said to be novel. They are wholly metallic and the result of many years experiment. The contact surfaces are flat and highly polished. One face is constructed of a series of metallic segments of a special composition, bolted to the gear wheel. The other is a steel ring bolted to the drum. The engagement is effected by the standard Lidgerwood friction screw and pin, but the very small movement required to disengage the polished flat surface is an important element not only in reducing the labor of winch operators but in conducing to high speed of operation, as the lever movement is very small indeed, even with the use of a fine threaded screw and long lever. As can be seen, the friction levers are brought to the front of the machine in pump handle fashion, so that there is one lever under each hand of the operator. The upright lever shown serves to reverse the machine. The throttle is controlled by foot pedals. Two band brakes are provided, but merely for emergencies. For all ordinary purposes the regular frictions are used. The operator therefore does not need to remove his hands at any time from the friction lever handles throughout the entire cycle of operation of a bucket.

The stearing gear consists of a Hyde steam screw steerer, with engines 10 x 8 in., and telemotor to pilot house, flying bridge and top of after deck house. Hand steering wheels are also fitted in connection with the steering engine.

The propelling machinery consists of two three-cylinder triple expansion engines 22 x 37½ x 60 in., with a stroke of 42 in.

On trial the engines of the Mars developed 3,818 I. H. P. with 93 R. P. M., and a working pressure of 200 lbs. at the throttle.

In the fire room are four single ended boilers, 15 x 10 ft., 9 in. long, and one donkey boiler of same type, 8 x 10 ft., 6 in. long. The main boilers have each three 44-in. diameter Morison furnaces, and the working pressure is 200 lbs. The total grate surface is 234 sq. ft., and the heating surface is 12,200 sq. ft. The Howden heated draft system is fitted.

The condensers, as shown are

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built in the engines, and have a tube surface of 7,200 sq. ft., and on trial a vacuum of 28 in. was obtained without difficulty. An auxiliary condenser of the Wheeler type with a cooling surface of 1,000 sq. ft., and air and circulating pumps attached is also installed.

The propellers are of the four-bladed built-up type, the hubs of semi-steel and the blades of bronze. The diameter is 14 ft. 9 in., with a pitch of 14 ft. 3 in., and a developed area of 66 sq. ft.

The installation of pumps is as follows: Two circulating double suction centrifugal pumps with 12-in. suction and discharge and driven by an 8 x 8 in. engine. Two air and bilge pumps attached to low pressure crosshead of main engines. Two vertical simplex feed pumps 14 x 10 x 24 in. One vertical duplex fire pump 10 x 7½ x 12 in. One vertical duplex ballast pump 12 x 14 x 12 in. One vertical duplex sanitary and fresh water pump, 5¼ x 4¾ x 5 in.

Two evaporators of the Griscom-Spencer type are installed, one for feed make-up and the other for drinking water. In connection with the evaporators is a distiller of the same make.

The electric installation consists of one generating set of 15 K. W. capacity, 125 volts direct current. This is direct connected to an 8 x 6 in. single vertical engine. The ship is wired throughout on the two-wire system with enameled steel conduit. An 18-in. 8,000-C. P. search light is located on the flying bridge. There are 135 16-C. P. lamps fitted throughout the ship.

An examination of the drawings will show an exceedingly simple and suitable design admirably adapted to the intended purpose, and in fact for bulk freighting in any trade. They probably foreshadow the ore ship of the Atlantic coast, as with slight modification as to hatch spacing and excepting for the bulkheads, they would work well under the same type of rig as is employed so advantageously on the great lakes ore docks.

The engines are of an unusually simple and pleasing design and, as well as the entire ship, as the REVIEW takes pleasure in testifying from personal inspection, bears all the evidence of first class workmanship.

The keels of all three ships were laid Oct. 5, 1908. The Mars was launched April 10, 1909, the Vulcan May 15, and the Hector July 3. Deliveries were made to the government Aug. 28, Sept. 15 and Oct. 20, which, as will be seen, is well within the time fixed in the specifications.

On the 24-hour trial the Mars maintained an average speed of 12.6 knots, the Vulcan 12.9 knots, and the Hector 13 knots.

The first views of the navy-built fleet colliers Vestal or Prometheus so far published are also presented herewith. It will be noted that in comparison the Maryland Steel Co's design loses nothing in respect of simplicity and business-like appearance, and further comparison with the plans published in the September REVIEW will only make satisfactory explanation of the enormous disparity in cost more difficult, though the handsome appearance of the Bureau design will be freely conceded.

THE NAVAL WASTE

IV*

IN earlier articles reference has been made to the waste of money in the building of departmental colliers. Seldom is such complete and satisfactory proof available as that which is now at hand in connection with this subject.

As early as April, 1908, the REVIEW called attention to the clamor of the navy for more colliers and the delay in proceeding with the construction of the two authorized four years earlier and at that time not yet even launched.

The appropriation for the two was $3,1000,000. The department was at that time asking for $7,000,000 to build four more of 7,000 tons capacity each.

The REVIEW claimed that three better ships could be built for the money the navy was spending on one. A month later the department secured authority to purchase three ships of 7,200 tons capacity at not over $525,000 each, practically the figure set by the REVIEW. Probably no one was more surprised than the department at the promptness with which bids were received offering to build the three ships for considerably less than the limit placed by congress, and in September, 1908, a contract was made for the three ships at a total of $1,470,000, or $490,000 each, with delivery not exceeding 14 months for all. Now mark the result. The first ship was delivered in August, 1909, the second in September, and the third and last in October, before the two government-built ships authorized in 1904 are ready for sea. As a matter of interest it may be noted in passing that according to the monthly summary of construction issued by the bureau of construction and repair the Vestal, building at the New York navy yard, advanced *one-tenth of one per cent in six months.**

Superiority of Private Design.

It will hardly be necessary to invite attention to particulars in order to demonstrate the superiority of the private design for the purpose intended. That the design makes for cheaper construction is not to be denied, but it is infinitely better for the purpose and the ship will not only last just as long as the bureau design but will cost much less for maintenance and will carry and handle her cargo for a fraction of the cost. Moreover, the coal handling apparatus will clear out the cargo holds of the contract design to the last ton, while the wings of the after holds in the bureau design cannot be cleared without shovelers. The one is modern and up to date and the other is antique. Note the tabulated comparison:

	Bureau design.	Private design.
Cost (one ship)	$1,550,000	$490,000
Time building	5½ years	11 to 13 [months
Cargo capacity, tons	6,400	7,200
Cost per ton	$242	$68
Displacement, loaded, tons	12,500	11,220
Ship, per cent of total, inc. fuel	53	28
Crew total	232	60
Horsepower	7,500	3,800
Speed, knots	16	12
Ton knots per hour	102,400	86,400
Coal per hour, 1½ lbs. per H. P.	11,250	30,240
Ton knots per ton fuel	15,930	30,240
Ton knots per ton fuel per dollar investment	1.00	3.5

Thus to move a ton of coal a mile with the bureau design the cost is 3½ times; the interest and depreciation 3½ times; fuel nearly double; wages and subsistence four times, as great as in the contractor's design, saying nothing about the difference in time of construction.

I am not overlooking what will be

*See introductory note in August issue.

*In the September number of the REVIEW are to be found plans and description of this ship and her sister, the Prometheus, and elsewhere will be found plans and description of the three colliers built under contract.

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called the "tactical value" of the higher speed, but that has already been appraised at its actual value as is demonstrated by the department's masterly retreat to the 12-knot speed.

Justification of Criticism.

Who will say in the face of these facts that the criticism of the naval administration is unjustifiable? If the public knew where to look they could uncover enough such instances to warrant wiping the department out of existence. We never hear the last of the demands for more money for colliers and auxiliaries. Why is the whole fleet of scrap colliers, for which we paid such fancy prices when war broke out, lying at navy yards while a horde of hungry foreigners are chartered to carry the department's coal?

The navy will go to any length to avoid extending a helping hand to the merchant marine. It would empty the United States treasury into the hands of foreign ship owners rather than give a dollar of it to American ships. It, as well as the army, have had even the coasting laws suspended in order to be able to give the business to foreigners. Assurances to the contrary are not made in good faith.

Attention has been heretofore drawn to departmental reports in pointing out the interminable delay in the execution of "urgently needed" work. The latest reports furnish additional enlightening examples, not without humorous features, as, for instance, it is evidently thought worth while to note that under an appropriation made in March, 1907, a contract for a water-closet in the Boston navy yard was completed within the time specified. The bureau has apparently become ashamed of continually reporting "nothing doing" on the wire rope mill for this yard, authorized in 1904, as it only referred to it as being in the plan and specification stage. The dry dock authorized in 1898 is "practically completed."

At Charleston rapid progress on the dry dock authorized in 1901 is being made; the erection of the pump house has been begun, and plans for bilge and keel blocks have been made. It is confidently expected that some day the dock will be available. Work is also progressing, or at least expenditures are shown, on numerous other items which have been authorized for seven or eight years.

Guam hasn't assumed much importance yet, so a building authorized in 1903 could hardly be expected to have gotten very far, but it is already occupied.

At Guantanamo work has started on the dry dock the department has been begging for four years and the work done during the year was chiefly for keeping the site pumped out so as to preserve the timber trestle work. The cemetery was also improved by work on the road leading thereto and will doubtless be even more popular than before. The bureau of yards and docks spent $15,500 towards the construction of the new dock but $23,000 for maintenance. It required a lieutenant-commander four months and an ensign six months, a chief boatswain and a chief carpenter to watch 33 men drive a few threads of oakum into the deck of a tug, patch up three coal barges and build a 14-ft. rowboat during the year. The cost of all this is not included in the $39,140 which was spent by the bureau of yards and docks.

At Mare island the dry dock authorized over 11 years ago (in 1898) has progressed so far that the excavation had been pumped out and the actual building started. The contract for the caisson was also let. Progress "quite satisfactory." Not a word about contractors (yet).

What the New Orleans Station Did.

At New Orleans the money for the upkeep of the naval station is still flowing into the Mississippi. It cost $337,490 for the year, exclusive of labor and material on construction or repair.

The number of men employed during the year varied between 20 and 146, average 35, exclusive of naval constructors and assistant naval constructors and chief carpenters and carpenters and foremen besides a "civil establishment" numbering eight. This expenditure includes nothing, of course, for interest or depreciation, insurance or taxes. The work done consisted of docking three vessels, of which two were army dredges and the third a small naval ship *belonging to a foreign government,* and the building of a gang plank.

The army dredges, by the way, spend a large part of their time in dry dock, as one of those referred to was on the dock over a month and the year before was also in dock a month. The second was docked in May and was still in dock at the close of the fiscal year. I believe I made earlier reference to government owned dredges. Those who have the curiosity to follow up that line will find it well worth their while.

Dry Dock at New York Yard.

New York navy yard has the same old story of delay in the "new" dry dock. "The contractor stopped work in August, 1906." Across the river whole tunnel systems have been built, the stupendous Pennsylvania and New York Central station undertakings have been projected and carried almost to completion since long after this hoary dry dock was started. The contractor is always to blame though the other projects are successfully carried out through the same agency. However, it is pleasant to be able to announce that a 15-ton auxiliary hoist for the 100-ton crane at this yard has been completed; it was only authorized in March, 1905. This hoist is full jeweled; only $20,000, and a quarter of it would be a good price for the purpose. I have seen it.

Norfolk yard has done much better on the dry dock authorized in 1900. The installing of the suction pipes for the pumps "was about to begi contractor, however, upset all calculations here also by failing to deliver certain parts of the capstan equipment, ordered during the year. A hurry-up job was done at this yard in piecing out a crane boom which was allowed in 1904.

Again the Contractors.

At Philadelphia (League island) the dry dock authorized in 1898 was still incomplete in August of this year. The contractors, confound 'em. The hydraulic press in the angle smith shop referred to previously is covered with lumber and the elaborate building is a carpenter shop, all of which goes to show how much the thing is needed or used and bears out the earlier statements.

The Puget Sound yard also contributes a few interesting items. The 1907 report, referring to the dry dock authorized in 1906 says "a location has been selected for the new dry dock and bids will be opened July 27, 1907." The 1908 report says "a location has been selected for the new dry dock and bids were opened July 18, 1908." The contractor got to work Jan. 1, 1909, after many delays and unwinding of much tape. This dock is to cost $2,000,000, that is, of course, without caisson or pumping machinery or buildings or capstans of power plant or bilge and keel blocks or dredging or traveling cranes or water and fire systems or in fact anything much but the hole in the ground. The contract for this much amounts to $1,625,000.

The department regards the contractor as an Ishmaelite and the reasons for the frequent failures are not hard to find. For instance, at the Puget Sound yard the department charged the contractor 7½c per kilowatt

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hour for electric power, while across the bay at Seattle the regular commercial rate is 2½c. The contractor has been obliged in self defense to install his own electric plant, though the yard, with no investment, interest or depreciation or insurance or tax charges, as customary in keeping all government costs, should have been able to undersell the private concern, to say nothing of a desire to facilitate progress. The navy is different, however. It may be well to add that the amount of this contract and the information regarding the charges for electric current are *not* from departmental reports.

Annual Reports are Certainly Amusing.

And so it goes all through the list. The annual reports ought to be far more popular than any "six best sellers." They are certainly more amusing and at least they are instructive. The estimates are a delight. There isn't a thing asked for that is not absolutely needed to stay in business. Compare the reports of the progress of the current year with the wailing and lamentation and prayers for more, of past years. The "bureau again invites attention to the necessity for additional dry docks." Perhaps if something were done towards completing those so long under way it would help. They certainly would be additional. At Charleston $20,000 is asked for an oil house and $10,000 for a shelter for a yard locomotive. Probably in Renaissance architecture.

To extend a crane track along one side of a dry dock, about five or six hundred feet, $25,000 is asked, about $230,000 a mile.

Cranes With Full Jeweled Movement.

A new 40-ton locomotive crane is wanted for Mare island at $55,000. This also is to be full-jeweled. The old has been in use 11 years and is worn out. Must be a mistake; nothing ever *wears* out in a navy yard. But the report insists that it is so, notwithstanding that there are hundreds of locomotive cranes in industrial plants all over the country running longer than that and doing more work in any one year than any navy yard crane in the United States has ever done since the first one was bought. Perhaps that includes the track. But no; here is the item for the track extension, $75,000. The length of the new dry dock where this track is to be extended is 752 ft., making the cost about $520,000 a mile.

Money is again asked for widening the 600-ft. channel at Norfolk "because it is too narrow to turn a naval ship." Any officer that cannot turn any ship in the navy in a 600-ft. channel is a dub.

Then general opinion of the handling of naval ships by their officers has been previously noted and comparison made with the work of ship masters of the great lakes.

Naval Officer's Amazement on the Lakes.

There has just come to hand as this is being written an expression from a naval officer who had made a trip from Lake Erie to Duluth on one of these inland steamships. The ship he traveled in has a displacement nearly as great as the biggest battleship in the navy, but low-powered and unhandy by comparison. It was his first visit to the great lakes and he said, "I have been sailing the oceans in the navy department for 25 years, and what I have learned of lake navigation on my trip has been a revelation to me. I want to say that as pilots and in the handling of big ships the lake skippers have the other sailors beaten to a standstill.

"I am positive there is not a man in the navy department who could safely bring one of the big lake ships from Lake Erie to Duluth."

Of course what the sailor calls "local knowledge" has some bearing on the case, but what the officer quite evidently had in mind was the handling of the ships, and he only admitted what every steamship master knows. It is no wonder that Admiral Goodrich has a spasm when he contemplates the locks in the Panama canal. The officials of the department nearly had heart failure over taking the battleship Mississippi up the Mississippi river a few miles where there is width and depth enough almost anywhere except at the Pass for a fleet.

The inevitable crane track is also needed at Norfolk, and $20,000 is wanted *for only one rail* alongside the dry dock.

For a bending shed $175,000 is asked and a smithery $150,000. There is no such money invested in these items in the busiest ship building plant in the country.

The naval prisons are among the hardest worked part of the equipment if the estimates are any indication. Portsmouth needs $250,000 *to complete* the one under way and wants it at once. It also wants a foundry at the same price. A pretty good foundry can be built for that money; one that can turn out more work than that at Portsmouth ever will can be built, with its equipment, for half of it. Key West also wants "a large well equipped foundry," but puts the price at $50,000. Probably a few figures inadvertently omitted.

Puget Sound wants a concrete anchor park at $5,000. Grading and concreting for the storage of all the anchors in the navy can be done at that price with room to spare.

The Iniquitous Special Item.

One of the most iniquitous features of the whole report is the "Special Item" regarding an appropriation for dredges for the department. It charges that there is a combination amongst dredging contractors and quotes the cost of dredging done by the army. The army has never dredged a yard of material in its history at as low a cost as it can have it done by private concerns. By its own method of figuring it can, and so can the navy but those methods are not even honest. They include no charge for interest, depreciation, management, insurance, taxes nor profit. Those things come out of the taxpayer just as though the contractor did the work and any effort to secure funds based on such a showing should be reprehended. Look at the time and money spent in dry docks by army dredges referred to above. Private dredges could not even live under such management, and this is not figured in government costs either.

Some Observations in a Navy Yard.

Recent observations in some of the navy yards will not be out of place here. Within a few weeks I watched seven men take 10 minutes to pick up and carry a 16-ft. length of 3-in. angle, weighing under 125 lb., about 20 yds. to a small hand-car and the whole seven exhaust themselves pushing the car with its burden along the level track. I saw three men helping a fourth to cut up scrap, by looking on with all their might. The machine in use was a large gate shear designed for large heavy work, the pieces of scrap weighed a few pounds. At another place a side dump car had dumped three or four tons of coal over a conveyor hopper and part of it had to be shoveled into the hopper. I saw six men rigging up a bit of canvas as an awning to screen them from the sun while they shoveled the coal, and was interested enough to make notes. It took the whole six 25 minutes to rig their awning and 20 minutes to finish the coal. One man might easily have done the actual necessary work in 15 minutes. All this in the New York yard. Under the stern of the Florida on the stocks a compressed air hose coupling blew out and the end of the hose dropped into the water,

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making a great commotion, much to the interest of everybody within sight and hearing and who all stopped work to watch it. For nearly half an hour the show continued before anyone made a move to shut off the line. These are merely samples of the indifference with which time and money are regarded in the whole system.

The Naval Gun Factory.

During a meeting of a well known engineering society in Washington a few months since, a number, including the writer, visited the naval gun factory. We commented on the speeds employed in turning large guns. We timed two or three different machines and the fastest was about 13 ft. per minute, the slowest about 11. Several of us had, a few days earlier, witnessed the same class of work in a private establishment where the cutting speeds were 40 to 50 ft. per minute. We saw gun slides, clean, mild steel castings, being bored at 12 to 14 ft. with a single tool, where the cut was not over ⅛ in. deep and the feed about 1-16 in. The speed should have been 50 ft., and with two or three tools in the bar. A brass lining was being bolted into a gun slide and five men watched one man pulling a drill by hand. A trunnion on a slide was being cut off by a series of operations with a fly-cutter, requiring hours and hours where a mill would have done it in minutes. Everywhere time is the thing of least importance. But a common handrail around a machine or an opening in the floor must have brass trimmings, a guard over a pair of gears must be of copper, polished, and brass trimmed; the substance neglected for the shadow.

At League island I watched a pattern maker making a pattern for a "chock." Its mate lay on the floor, marked "Kansas". Now everywhere this class of work is looked upon as of the most transitory and unimportant character and only enough work put upon the patterns to enable the foundry to produce a casting. But the navy is different. Those chock patterns were as carefully and expensively built as a piano and as though they were to be used on repetition work and intended to last a lifetime. For every dollar that was necessary ten were spent.

Work is done every day in the navy yards that would not be accepted from any private concern. There are just as many unfair holes and just as many poor rivets and just as much poor fitting in the navy yard built ships as in any old tramp built under a classification inspection; I have seen some of the latter that put the navy yard work to shame. The steel foundry (also referred to previously) at New York gets just as many poor castings off its hands as any other foundry, and it does not turn out a pound that does not cost three times what the same grade can be bought for. When Mr. Landis called the navy a bluff he applied the right term. It is worse; it is a fraud. It is a huge sink hole, but it is popular. What the navy needs, or rather the people who foot the bills, is a few men on the naval committee who have some practical knowledge. Just as long as these things are in the hands of lawyers the department can get away with the swag, because no one knows any better.

The Navy and the Merchant Marine.

THE MARINE REVIEW announced before beginning the publication of these articles that it was moved to do so by the attitude of the navy towards the merchant marine. It takes occasion to say once more that it is not opposed to a navy in the second place with the commercial interests of the country first, but it is opposed to the navy's methods and to the enormous appropriations made for it annually while the merchant marine not only cannot get any assistance, but the navy seeks to take from it even that which has always belonged to it, the carriage of the country's own supplies, and to build up an unwieldy institution which will come to be regarded with more hatred and contempt than respect. Admiral Evans has only recently voiced the real feeling of the navy when, professing sympathy with the merchant marine, he said in the same breath that the navy was no longer dependent even slightly upon the merchant marine for men, and that 24 hours at sea would give the greatest greenhorn his sea legs. Well, the chief of the bureau of navigation in his report says that it takes six years to train a man-of-war's man. Oh! if we only had more Evanses. We wouldn't need a navy at all. The navy has its ba-ad men with near-belligerent handles bestowed by impressionable news-writers and emotional women and who form part of the whole which has been fitly and truthfully called a "bluff".

Those who take umbrage at the appellation had better call off the assistant secretary of the navy, who has over his own signature stated that the ships of the navy could not go to sea without a certain particular coal which is mined in the east. The navy needs delivery from its friends.

BRITISH TANK STEAMERS FOR THE PACIFIC TRADE.

One of the most important of this year's transactions in the tank steamer business has been the equipment of the Pectan of the Shell line, and the Oberon and Trinculo, owned by Messrs. C. T. Bowring & Co., with the Meyer's system of oil fuel burning and the chartering of these steamers to run in the California oil trade. The oil-burning trial of the Trinculo off the Tyne occurred on Tuesday, Sept. 28.

Owing to the strong easterly wind and occasional wind squalls the Trinculo did not leave the river in the early morning, but at 10 o'clock the company invited to be present went on board off Smith's Docks, North Shields and before 11 o'clock the large steamer (she carries 7,500 tons of oil) was steaming out to sea.

It was found when the Trinculo got outside the piers that the weather was too hazy for the officers to make out the landmarks on the measured mile, and it was decided to take the runs by the log. Naturally, interest in the trip centered in the stokehold equipment and the work of the engines running under oil fuel. The system was most carefully studied and the results, which were secured with a fuel oil supplied by the Anglo-American Oil Co., were satisfactory from the two most important points of view—low consumption and increased speed. The vessel ran slightly more than 11 knots, and, working under trial trip pressure had a fuel consumption that worked out at 24 tons a day. Before the fireboxes were warmed up (the steamer having come straight out of the river to run her trial) the furnaces gave off some smoke, but before the run was finished there was perfect combustion, and the engineers expressed themselves thoroughly satisfid that on the run out to the Pacific the vessel will make some interesting records in this particular trade.

Distribution of Oil as a Spray.

The feature of the system is the distribution of the oil as a spray in the furnace in a heated condition and under pressure from an oil pumping plant. On the occasion of the Trinculo trial the company were shown a simple hand pump and spraying contrivance working with water. This gave a fine spray reaching away four or five feet from the nozzle. The arrangement elucidated points not easily grasped during a visit to the stokehold.

The pumps are in duplicate, one being for use while one is in reserve. A suction heater has two filters, one of

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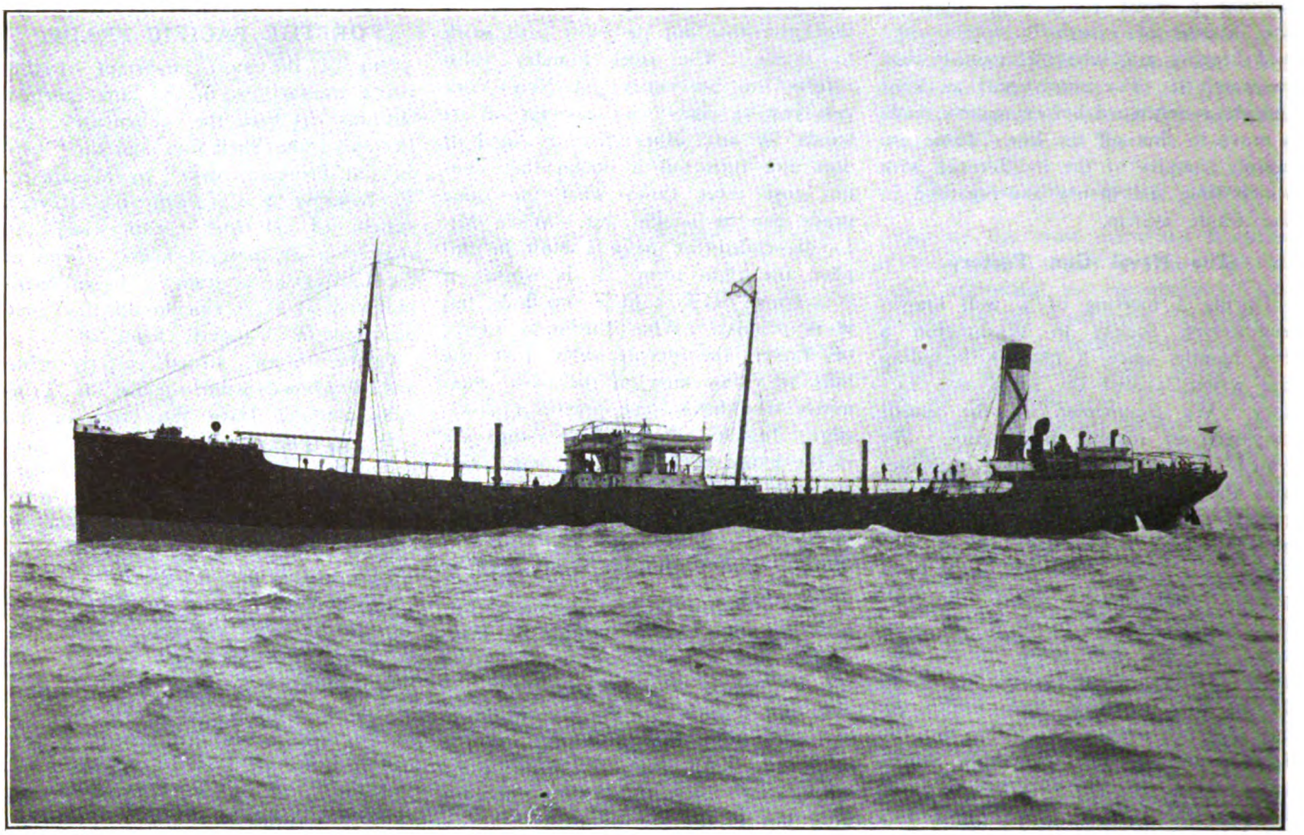

BRITISH TANK STEAMER TRINCULO.

which can be used while the other can be cleaned. There are also two delivery heaters, of which one is always in reserve. The general construction of these heaters consists of a chamber within which heating pipes are arranged, the suction heater having its duplicate filters arranged one on each side. Steam is supplied and passed through three stop valves and pipes to the coils of the delivery and suction heaters, and leaves them by pipes connected to the main exhaust pipe, which also takes the exhaust pipe of the pumps.

The pipes from the various fuel tanks in the vessel are led to a distributing box having a stop valve for each tank, and this box is connected to the pipe communicating with the suction heater. The pump sucks the oil through the pipe from the filter out of the suction heater and delivers it through to one of the delivery heaters in use, and thence through a pipe to the furnaces. Each furnace is provided with a distributing box having four valves and four jets (one valve for each jet). Each jet consists of a nozzle having a needle spring pressed into place by a spring and end cap, and is also provided at its end with a screwed portion by which the oil under pressure is sprayed into the furnace. The fuel delivered is regulated by the stop valve of each jet and any excess delivered by the pump is discharged through the spring pressed by-pass valve back to the suction heater, so that the stokehole regulation can be carried out without reference to the speed of the pump, although naturally this latter is regulated under conditions just above the maximum demand for the sake of economy.

The furnace front is fitted into the furnace tube so as to leave an annular space between the front and the furnace tube, while the periphery of the front has angularly disposed ribs by which the air is heated in its passage through the annular space. Upon the furnace front and covering the annular space is a ring damper having a screw arrangement on its inner surface which co-acts with studs on the furnace front, having the function of a male screw. On the ring being rotated by the handle, the face of the ring can be brought up to and be receded from the furnace front, so that the area of the air passage can be regulated at will.

It is worthy of special mention that the converting of the vessel back again to coal was accomplished in the short time of 48 hours, without interfering in the slightest with the taking in of the bunker coals.

S. S. Trinculo.

Details of oil fuel trial with Meyer's liquid fuel installation:

Engines:
26 in. x 43 in. x 72 in. x 48 in. stroke.
180 lb. working pressure.
Total heating surface 7,281 sq. ft.
Mean speed 11.1 knots by log.
Revolutions 68 to 69 per minute.
Steam pressure 173 lb.
Pressure in M. P. chest 68 lb.
Pressure in L. P. chest 13 lb.
Vacuum 25 in.
Indicated horsepower on trial 2,417.
Consumption of fuel per I. H. P., 94 lb. of oil.
Specific gravity of oil fuel 65.3 degrees Fahr. 895 and equal to about 40.15 cu. ft. per ton.
Pressure of oil at heaters 25 lb.
Mean temperature of oil at burners 200 degrees Fahr.
Mean temperature of furnaces at front of striking column I. E. 5 ft. 9 in. from furnace fronts taken with a Siemen's water pyrometer 2,290 degrees Fahr.
Temperature 3 ft. 6 in. in from furnace front by thermo-pyrometer, 1,870 degrees Fahr.
Temperature in air conveyor passages 9 in. in from front 370 degrees Fahr.
Temperature at base of funnel 520 degrees Fahr.
Temperature on deck 58 degrees Fahr.
Temperature in stokehold 85 degrees Fahr.
Air passing through each front per minute 3.322 cu. ft.
Air passage down one ventilator per minute 12.964 cu. ft.
Pressure in stokehold 2.3 lb.

The following auxiliaries were also working:

Steam steering gear, dynamo, Weir's feed pumps, Gwynes circulating pumps.

Charles L. Rohde Sons, Baltimore, have been awarded a contract by M. W. Adams to build three large open lighters.

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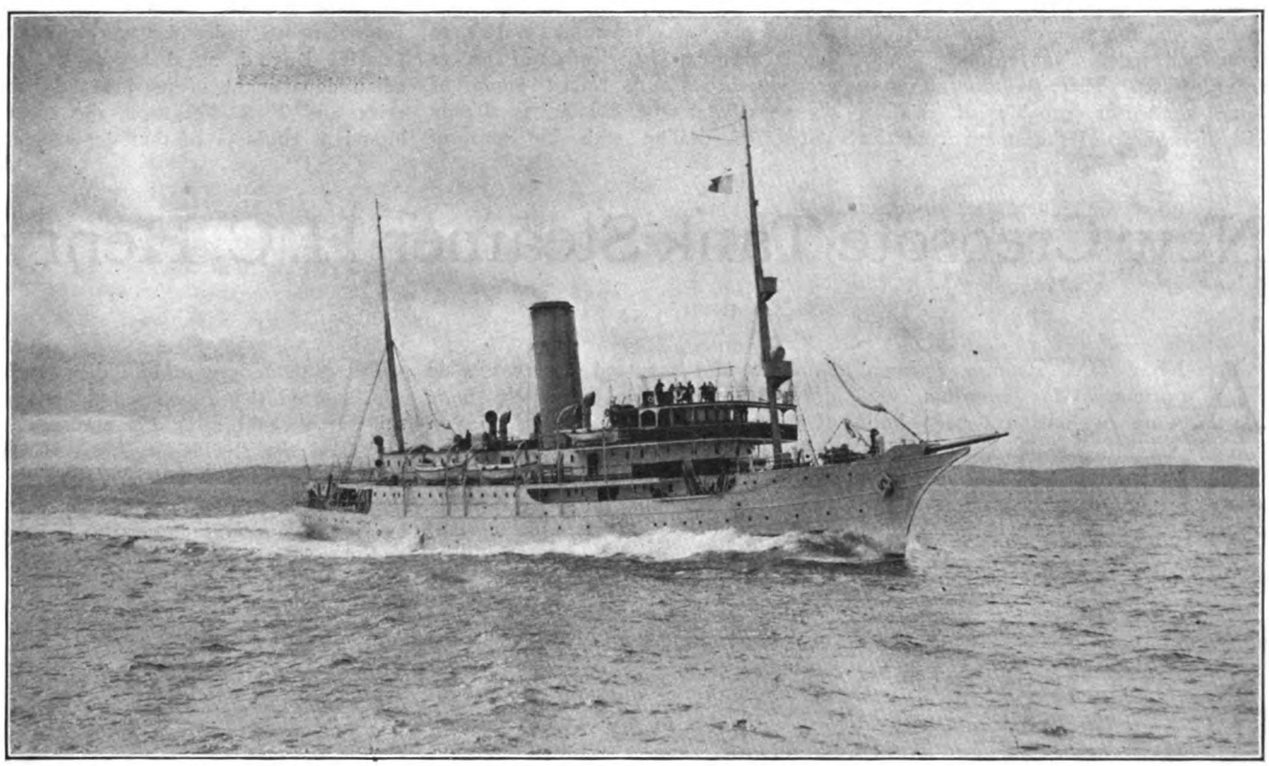
The Canadian Ice-Breaker Earl Grey

THE success of the Canadian ice-breaking and survey steamer Lady Grey, completed three years ago at the Vickers works, Barrow-in-Furness, has encouraged further development in the same direction. This earlier vessel, Lady Grey, has done excellent work in breaking up the ice in the St Lawrence river, and when not thus engaged has performed various duties associated with the marine and fisheries board. The Canadian government in consequence decided to order another and larger vessel, and there has just been delivered to the government of Canada a steamer which has been designed and built by Messrs. Vickers Sons & Maxim, Ltd., of Barrow-in-Furness, to play many parts. The Earl Grey has all the qualities in respect of appearance which are desirable in a private yacht, having a fine shear, a cut-water stem, a short bow-sprit, an elliptical stern, two pole-masts with considerable rake and schooner rigged. She has the appearance and dignity justifying her use by the governor general of the Dominion. In addition to the internal accommodation for the vice-regal party, she has admirably arranged quarters for 50 first-class, and 20 second class passengers, so that she may be utilized in the important service between Prince Edward island and the mainland when not otherwise required. The Northumberland straits, across which she will thus trade, is, in the winter season, blocked by pack-ice, and the vessel has been built with scantlings and other features to enable her to cut her way through the ice-floes, as well as to assist in keeping the Gulf of St. Lawrence open to navigation. Thus the shell plating is thicker than usual, and the outer skin is doubled along the water line right fore and aft, and to the keel in the forebody, where the friction of the ice tends to wear away the material faster than in ordinary marine practice, specially large tanks are provided fore and aft with extra powerful pumps, so that increased weight can be quickly provided to enable the forefront, or stern, after it has mounted the ice, to break through it by downward thrust. The rudder takes the form of the hull, so that the movements of the ship ahead or astern, will not in any way be impeded by the ice-floes.



THE CANADIAN ICE-BREAKING STEAMER, EARL GREY.

Speed Trials of the Earl Grey.

All these special conditions added to the difficulty of attaining high speed. The Vickers company however, guaranteed 17 knots on a displacement of 3,400 tons with a draught of 17 ft. 7 in. notwithstanding that the vessel is only 250 ft. long, 47 ft. 6 in. beam, and 26 ft. 6 in. molded depth. On the official trials this speed, and the other requirements in respect of rapidity of maneuvering and variation in trim were excelled. On one of the trials the speed was 18.44 knots. The first of the trials consisted of a series of progressive speed double-runs on the measured mile on the Clyde, from 10 knots to approximately the full speed, the maximum on this series being 17.739 knots with 6,985 I. H. P. The vessel was next required to steam six hours at full speed; but before running on this test, six runs had to be made on the mile. The mean result was 17.94 knots, the speed on two runs being 18.001 knots with 7,578 I. H. P. at 125 revolutions. The average speed on the six hours trial, reckoned on revolutions, was close upon 18 knots, or a nautical mile per hour in excess of the speed expected by the Canadian authorities. For ice-breaking purposes the power guaranteed was 6,000 I. H. P. and this was exceeded by 800 I. H. P. The turning and manuevering trials were carried out to the satisfaction of the representatives of the Dominion government. The machinery is of the triple-expansion three-crank type, and in the design the heavy stresses to which the vessel will be subjected in ice-breaking have had special consideration. Consequently, the shafting and the work-

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ing parts are of considerably greater strength than usual. This also applies to the propellers, which are of the four-bladed built-up type. The blades, which, like the bosses are of cast steel, are of exceptional strength for working through ice. The engine cylinders are of 27½ in., 43 in., and 70 in., in diameter respectively, with a stroke of 39 in. Steam is supplied at a working pressure of 180 lb. from four boilers of the cylindrical type, 15 ft. in diameter. Two of these are double-ended, being 21 ft. long, and 2 single-ended 11 ft. long. The boilers are fitted with furnaces of the Morrison suspension type, and work with the Howden system for forced draft, the air being supplied by three fans driven by enclosed forced lubrication engines. The main condensers are cylindrical in form, and independent twin-air pumps are provided. There is also an auxiliary condenser capable of dealing with the whole of the steam from the auxiliary engines, and having separate air pumps.

Special Arrangement of Pumping Plant.

Special arrangements have been made in connection with the pumping plant, owing to the special duty of the ship in the ice-floes. In the event of the ordinary suction or discharge valves being choked with ice, the circulating water may be drawn from or discharged into a part of the double bottom, two frame-spaces being specially divided off for this purpose. In the way of these the outer skin of the ship is perforated in such a manner as to give a large area for the passage of the circulating water. Steam jets are arranged on the branches of all sea inlet valves, to enable them to be cleared of ice as occasion arises. A ballast pump of the centrifugal type, capable, as already stated, of dealing with 250 tons of water per hour, is fitted in the engine room, with connections for transferring water between the forward and aft tanks when trimming the vessel for making its way through the ice.

In addition to the usual feed, bilge, and sanitary pumps, the machinery department is fitted with evaporating plant, grease-extractor, feed heater, and Stone's ash-expellers, the equipment generally embodying the latest up-to-date practice for this class of vessel.

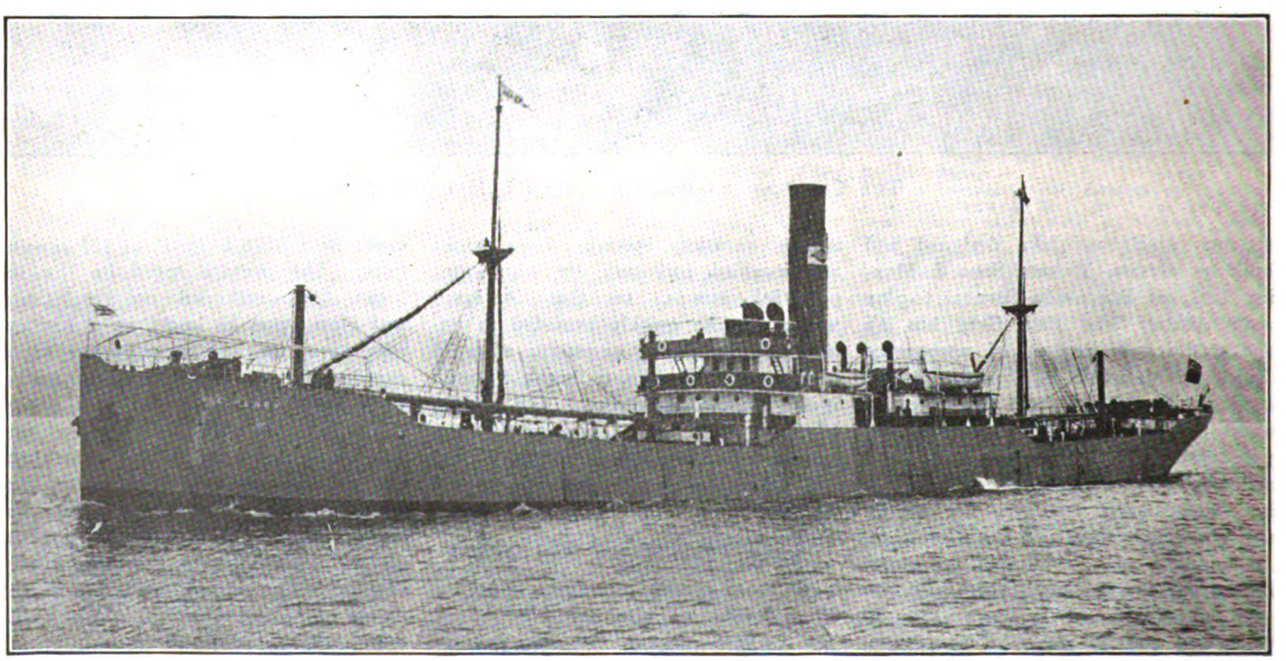
A work shop for repairing purposes is also installed on the vessel, the lathes and other machines being driven by electric motor.

The ship and machinery have been built to the requirements of the British board of trade, Lloyds Registry of Shipping and the Canadian steamboat inspection act, under the supervision of Charles Duguid, naval architect, Canadian department of marine and fisheries, and T. R. Ferguson, the superintendent engineer of that department.

New Creosote Tank Steamer H. C. Henry

By H. Cole Estep.

A NEW tank steamer designed primarily for carrying creosote in bulk has been built recently by the Pacific Creosoting Co. of Seattle and has been placed in regular service carrying creosote from European ports to the company's creosoting works at Eagle Harbor near Seattle. Previously the company had imported its creosote in drums, there being practically none of domestic manufacture available on the Pacific coast. This was an inconvenient and unsatisfactory method and there was always some loss by leakage and more or less damage to the packages. Recently also a ruling has been made requiring the payment of an import duty on the drums. It was decided therefore to build a vessel which could carry the creosote in bulk and the steamship H. C. Henry is the result. Although designed primarily for creosote carrying, the Henry can carry any liquid cargo in bulk and has considerable space between decks for dry cargo as well. The



Tank Steamer H. C. Henry Built for the Pacific Creosoting Co. of Seattle.

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steamer represents the most advanced ideas in tank ship construction.

A study of the vessel reveals the three principal requirements uppermost in the mind of the designer: Ample strength to battle with the heavy storms encountered on long voyages, especially those which frequently rage in the vincinity of Cape Horn; large cargo capacity coupled with reasonable speed, and finally, ample bunker capacity and large steaming endurance for long trips.

The hull is built of steel to Lloyds classification and is provided with special stiffening members on each side just forward of the funnel as well as a center longitudinal bulkhead which divides the port and starboard oil tanks and gives the vessel considerable additional longitudinal strength.

The vessel is 360 ft. in length between perpendiculars, 49 ft. beam, with a molded depth of 29 ft. 4 in. to upper deck. Her deadweight capacity on 24-ft. draught is 6,100 tons. The engine and boilers are placed amidships, with cargo tanks both forward and aft. There are three cofferdams; both fore-and-aft and transverse oil tight bulkheads separate the various oil tanks from each other and from other parts of the vessel. There are four oil holds forward of the machinery and three aft; each hold contains two tanks, one port and one starboard, making 14 tanks in all. In addition there are four small summer tanks situated aft of the engines and above the main tanks.

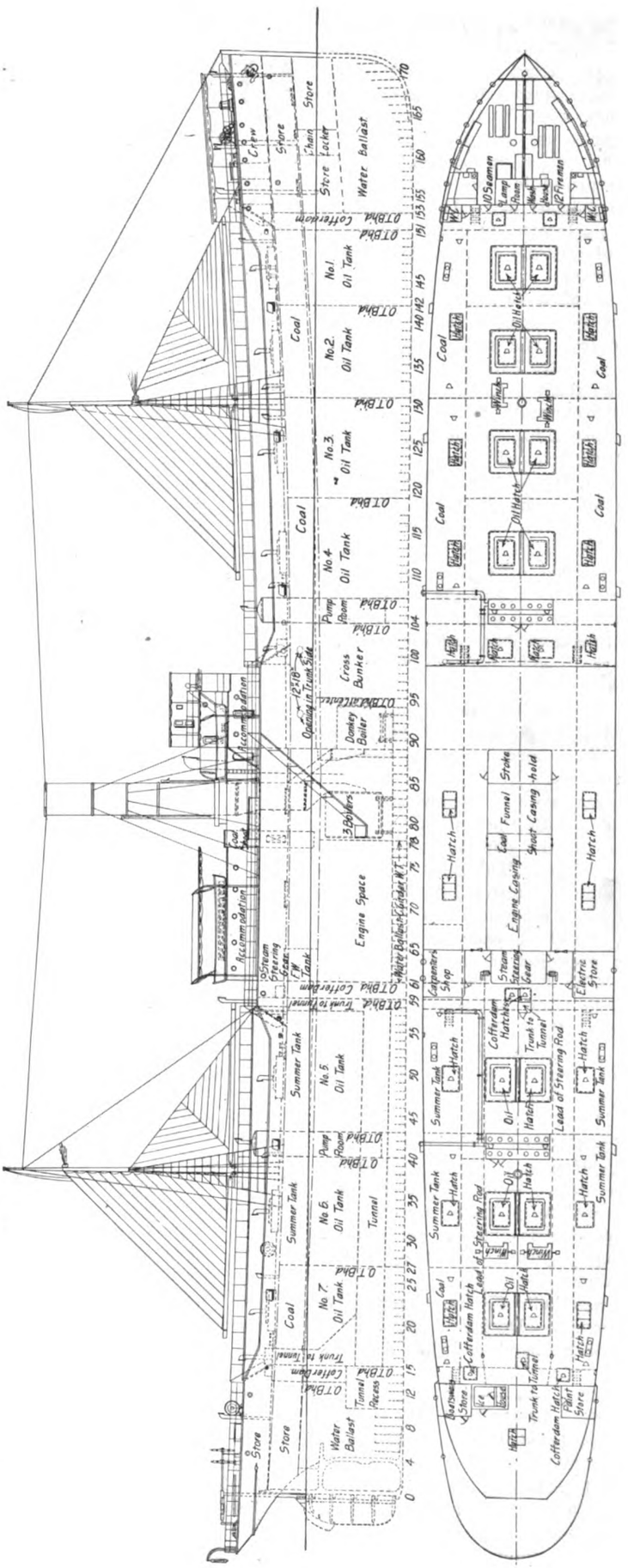
When carrying creosote under ordinary conditions No. 1 tanks and No. 7 tanks are not loaded. The capacity of the vessel in tons, carrying creosote is as follows:

Tank	Tons
No. 2, port	439
No. 2, starboard	439
No. 3, port	478
No. 3, starboard	478
No. 4, port	461
No. 4, starboard	461
No. 5, port	593
No. 5, starboard	576
No. 6, port	447
No. 6, starboard	439
Total	4811
Summer Tanks	
No. 1, port	69.5
No. 1, starboard	69.3
No. 2, port	63.1
No. 2, starboard	63.1
Total of Summer Tanks	265.2
Total creosote capacity, tons	5076.2

This is the maximum capacity; the net capacity allowing 3 per cent for expansion is 4,923.9 tons.

In addition, the bunkers have a capacity of 1,885.8 tons of coal and there is provision for 495 tons of water ballast.

There are two pump rooms, one forward and one aft, each fitted with



PROFILE AND SPAR DECK PLAN, TANK STEAMER H. C. HENRY.

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double acting steam driven oil pumps. Steam is furnished by a large donkey boiler located in the stoke hold. The pumps are placed as low as possible. An 8-in. suction main leads from each pump room to the various tanks. Goosenecks are led from this main into the tanks terminating in bell mouths placed low so that the tanks can be pumped dry. The controlling valves are located on deck. The entire cargo of creosote can be pumped out in 20 hours.

There are seven cargo hatches, four forward and three aft, and seven cargo winches. The hatches are double; the large outer hatches are for general cargo and the smaller inner hatches are for loading oil.

The propelling machinery consists of a triple expansion engine with cylinders 24, 41 and 68 in. diameter with a common stroke of 48 in. Steam is furnished by three Scotch marine boilers of the usual type. The donkey boiler is also of the Scotch marine type and is located in the stroke hold. Forward of the donkey boiler is a large cross bunker, additional bunkers are situated between decks forward and aft.

On her trial trip the H. C. Henry reached a speed of 11.75 knots per hour. Her normal loaded speed is eleven knots.

The forecastle is roomy and comfortable. With the exception of one spare room, the ship has no passenger accommodations. The cabins are amidship and are tastefully fitted; each officer has a separate room.

The vessel is named after H. C. Henry, president of the creosote company. The house flag consists of a blue field with red diamond, bearing the name Rood in white letters in honor of H. R. Rood, vice president and general manager of the Pacific Creosoting Co.

The H. C. Henry has made one trip from Great Britain to Puget Sound, bringing a cargo of 1,500,000 gallons of creosote. Although she encountered very heavy weather she made good time and her performance was highly pleasing to her builders and owners.

She was built by the Greenock & Grangemouth Dockyard Co., Ltd., Greenock, Scotland, and flies the British flag.

The City of Philadelphia, building at the yards of Harlan & Hollingsworth at Wilmington, Del., will probably be launched in December. This vessel is being built for the Wilson line to run between Wilmington, Chester, and Philadelphia.

Ship Building on the Delaware

UPWARD of $25,000,000 of work is now in hand in the various ship yards on the Delaware, and with inquiries coming in steadily, as a result in the increase in the greater volume of commerce, it is generally expected that before the oncoming of winter all of the establishments will be at work, with virtually 100 per cent of the working force that they employed when in full swing before the depression.

The William Cramp & Sons Ship & Engine Building Co., with almost 4,000 men now employed, will increase this force, as soon as the 26,000-ton battleship Wyoming, now under contract, is laid down. The New York Ship Building Co., with 3,000 now at work, is steadily building up its yard force from the men whom it was obliged to lay off many months ago.

With the present outlook for business in the ship yards, the Philadelphia navy yard, which will have a large volume of repair work throughout the fall and winter, is concerned over what promises to be a great scarcity of skilled labor.

There are now under contract for construction in the Cramp yard not less than nine war vessels, the unfinished work of which represents upward of $10,000,000 of business.

The battleship South Carolina is still in the yard, and is being installed with an electrical outfit. It is expected that the work will be finished early in November, when the ship will be turned over to the government.

The destroyer Joseph B. Smith is also passing through the finishing stages, having made her trial run successfully and having demonstrated that, next to the Flusser, she is the fastest among the nation's vessels. She, too, will be delivered in November. The destroyer Lamson, a sister ship of the Smith, is 95 per cent completed and is almost ready for her trial trip. Like the Smith the Lamson was built for 29½ knots, and it is hoped that on the coming trial a speed equaling the Flusser's 33 knots will be attained.

On the stocks and almost ready to launch are the destroyers Warrington and Mayrant. It is probable that they will not go into the Delaware until spring. The contract speed of these two is 30 knots, half a knot greater than the Smith and the Flusser, and it is the hope that when completed one of the pair will give the speed record to the Cramp yard. Still another destroyer, No. 36, unnamed as yet, is in the early stages of construction, the frames now going up.

There is also on the ways the collier Cyclops, one of the largest of the colliers built for the navy. The vessel is 35.5 per cent along toward completion and will not be launched until spring. Besides these warships the yard is building for the government three tugs for harbor service. Keels are already laid for these.

Most important of the lot, however, is the 26,000-ton battleship Wyoming, the contract for which has just been made. The work of preparing the ways for the new ship, which will out class any of the American navy now afloat, is going forward, and the keel will be laid in the winter. The contract time is 32 months and the ship is to attain a speed of 20½ knots.

Besides these the yard is now making extensive alterations and repairs to the Creole and Comal of the Southern Pacific fleet, which have been withdrawn from the New York-New Orleans service for the time necessary for their overhauling. The Creole is being fitted with reciprocating engines, while the Comal is having new boilers installed.

Equally busy on government work is the New York Ship Building Co., in Camden. The destroyer Preston returned a few days ago from a successful builders' trial. The destroyers McCall and Burrows are to be delivered in 1910. The battleship Utah is now 40 per cent completed and not yet launched. The company has also under contract destroyer No. 35, which is not laid down.

There is also to be built the 26,000-ton battleship Arkansas, sister ship of the Wyoming, so that the Delaware is to turn out the two largest ships thus far projected by the government. Already the company is ordering material for this ship.

In the matter of merchant vessels, the yard is also very busy. It is, first of all, building a transfer car barge for New Orleans. This is designed to carry an entire passenger train around the city, as the Federal and Colonial expresses are conveyed around New York on the Maryland. This barge is 360 feet long and will be finished in November.

Two coal barges, each 200 feet in length, are being built, one for the Delaware, Lackawanna & Western and one for stock. There are also under contract two colliers for the Coastwise Transportation Co. to operate between Norfolk and Boston.

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Experimental Spur-Wheel Reduction-Gear for High Speed Steam Turbines

Introductory.

ABOUT six years ago, Rear Admiral George W. Melville, ex-engineer in chief, United States navy, and John H. Macalpine, consulting engineers, undertook at my request a thorough investigation of the then existing status of the steam turbine as applied to the propulsion of ships, and the probabilities of its becoming the ultimate successor of the highly developed types of reciprocating engines commonly used for that purpose.

The data gathered in the course of the investigation and the conclusions drawn therefrom, were embodied in an exhausting and interesting report which was delivered to me by its authors in May, 1904. Because of the universally recognized high standing of Admiral Melville and his associate as authorities in matters pertaining to marine architecture and engineering, and because the report was such a complete, temperate and logical exposition of the marine steam turbine situation at that time, I considered that the information collected was of more than passing personal interest, and I had a limited number of copies of the report printed for private circulation, in order that others might benefit by a plain dispassionate statement of fact, stripped of the fanciful embellishments with which a novel departure from established lines of practice is apt to be adorned unconsciously by over-enthusiastic advocates.

The report of May, 1904, was not of a very encouraging nature, but in the few years that have intervened, there have been developments which effect a radical change in the situation existing at that time. This original report has been incorporated as a supplement to the accompanying description of certain interesting and important work that has been carried out by The Westinghouse Machine Co., at East Pittsburg, Pa., under the direction of Messrs. Melville and Macalpine, and by comparison, it gives one a vivid impression of the rapidity with which history is made in the engineering art.

The most significant statement in the report of May, 1904, is to be found in the conclusion. It reads as follows:—

"If one could devise a means of reconciling, in a practical manner, the necessary high speed of revolution of the turbine with the comparatively low rate of revolution required by an efficient propeller, the problem would be solved, and the turbine would practically wipe out the reciprocating engine for the propulsion of ships. The solution of this problem would be a stroke of great genius."

There could be no greater tribute to the far-seeing and well-balanced judgment of the authors of this report, than the fact that nearly five years later this identical sentiment was publicly voiced not only by James Denny, of Denny & Brothers, Dumbarton, Scotland, the oldest and most experienced builders of turbine-propelled vessels in the world, and the most consistent advocates of the system, but also by the Honorable Charles Algernon Parsons himself, by whose brilliant creative imagination, the basic idea of the modern marine turbine was conceived, and by whose courageous initiative it was made an accomplished fact.

James Denny Voices Same Sentiment.

The parallelism of thought is so unusually striking that I quote the utterances of Mr. Parsons and Mr. Denny verbatim, as reported. Mr. Parsons, in concluding his James Watt anniversary lecture, delivered at Greenock, Scotland, on Jan. 15 of the present year, said:—

"We might naturally speculate as to the future, and inquire if there is a possibility of the turbine being constructed to run more slowly, and without loss of economy, or whether the propeller can be modified to allow of higher speeds of revolution. Or again, may the solution be found in reverting to some description of gearing—not the primitive wooden spur gearing of half a century ago, but to steel gearing cut by modern machinery with extreme accuracy and running in an oil bath, helical tooth gearing or chain gearing, or again, some form of electrical or hydraulic gearing? These are questions which are receiving attention in some quarters at the present time, and if a satisfactory solution can be found, then the field of the turbine at sea will be further extended."

Mr. Denny, in his presidential address to the Institution of Marine Engineers, in Britain, on Oct. 5, 1908, said:

"It has frequently been suggested that if some inspired engineer would evolve a system of gearing that would be lasting and reliable, not too noisy, and would not absorb in friction more than say, 10 per cent of the power, turbine engines would be capable of application to any speed of vessel, and to any size of propeller; you would then have a high-speed turbine and a low-speed propeller, which is the ideal condition for marine propulsion."

Solving the Problem.

The problem first recognized by Messrs. Melville and Macalpine, and the importance of which has since been admitted by Mr. Denny and Mr. Parsons, has been solved. It has been solved by Messrs. Melville and Macalpine themselves, so that by one of the amusing freaks of fate, the compliment to the then unknown solver, implied in the last sentence of the paragraph quoted from their report of May, 1904, comes back to rest upon its unsuspecting makers.

The desired end has been accomplished by means of a reduction gear, which makes possible any reasonable speed ratio between the turbine shaft and the propeller shaft. It was no easy task to design a system of gearing that will operate quietly and without destructive wear at the speeds common to steam turbines of the highest efficiency, and at the same time be capable of transmitting thousands of horsepower. The details of the design that has proven itself capable of fulfilling these requirements, are fully set forth in the able and comprehensive article reprinted from *Engineering* (London, Sept. 17, 1909), which is based on data supplied by Messrs. Melville and Macalpine. However, a few additional words of a non-technical character, generally descriptive of the gear, and indicative of its significance as a factor in marine construction, will not be out of place.

Description of the Gear.

The teeth of the gears are helical, that is to say they do not run straight across the face of the wheel parallel to the axis, as in the case of ordinary spur gears, but they are cut in the form of a steep spiral, like an exaggerated screw thread. This construction allows the teeth to roll into contact without shock or jar. If there were only a single gear on each shaft this helical form of tooth would cause an objectionable end thrust. As the gears must be very wide to transmit the enormous powers required in marine service two gears, each of half the required width, are placed on each shaft, with the spirals of

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the teeth running in opposite directions. In this way the end thrust due to the obliquity of the teeth is completely balanced. With a pair of wide-faced gears with straight teeth, it is hardly possible to cut the teeth with such accuracy and to align the shafts so perfectly as to get uniform contact throughout the entire length. Even if it were possible to secure the requisite degree of accuracy at the outset, it could not be permanently maintained on account of the natural wear of the bearings. In general, the conditions are such that a rigidly confined set of gears such as are common for moderate speeds and powers, is altogether inadmissable.

In the design which has proven its sufficiency under severe and exhaustive tests, the smaller gear or pinion is mounted in what the inventors call a "floating frame." The frame which carries the bearings for the pinion is a heavy steel casting supported only at a single point midway between the bearings. The support is flexible so that the frame is free to oscillate in a vertical plane passing through the axis of the pinion, but is held securely against motion in any other direction. Furthermore, the pinion is free to move endwise in its bearings. Any tendency of the teeth to bear harder at one end of the gear than the other would tend to unbalance the respective end thrusts due to the right and left hand spirals of the teeth; but as the pinion cannot present any resistance to unbalanced end thrust, it constantly adjusts itself in the direction of its axis to the position corresponding to equilibrium between the opposing forces. This means that the tooth contact pressures are always automatically equalized.

Functions of Floating Frame.

If there are any minute irregularities in the spacing of the teeth, which would tend to make the contact harder at one point than another in any part of the revolution, this tendency is defeated by the floating frame, the position of which about its central support or fulcrum is controlled solely by the pressures of the teeth of the pinion against the teeth of the large gear. Naturally, the floating frame always yields under the slightest tendency of an unbalanced contact pressure in such a way as to transfer the smallest increment of unbalancing pressure, to another section of the gear that in the absence of the floating frame would be less inclined to take its full share of the stress. In short, the gears are self adjusting to relieve and equalize all abnormal strains, and are consequently independent of the small inaccuracies that are impossible to eliminate in the best commercial manufacturing operations.

The probable efficiency of the gear was naturally the most anxious question, as the operating conditions were so wholly unprecedented that there were no existing data to enable one to even hazard an estimate. The effect of a low efficiency would be more serious than a mere impairment of the economic performance of the installation, as the transmission losses would manifest themselves in heating and destructive wear that would mean hopeless failure for the scheme in its entirety.

In order to definitely settle the question as to the practicability of the gear, it was necessary to devise methods, and to design and construct special appliances for testing it under all of the conditions of load and speed that would probably obtain in actual commercial service. The dynamometer for applying and measuring the loads to which the gear was subjected, will, I trust, be considered sufficiently novel and interesting to warrant the extended description that will be found in another part of this publication.

Considering the important bearing of the question of efficiency on the ultimate success of the gear, it is peculiarly gratifying to have found by repeated trial and careful measurement, that the transmission loss hoped for by Mr. Denny, has been divided by seven. To be exact, the efficiency reaches the almost unbelievable figure of 98.4 per cent, a result that is without doubt inseparably connected with the flexibility and self-adjusting character of the apparatus.

It is needless to say that the gear is enclosed in a substantial casing, that adequate means are provided for its constant and efficient lubrication, and that the ingeniously designed connections between the gear and the turbine effectually prevent the self-adjusting movements of the pinion from communicating any longitudinal or transverse stresses to the turbine shaft.

Now that the mechanical operation of the gear is no longer a matter for speculation, it is interesting to consider its bearing on the design of turbine installations in ships.

Turbines of Giant Cunarders.

The turbines of the giant Cunarders, Mauretania and Lusitania, are supposed to be capable of developing 70,000 shaft horsepower. Even the comparatively low speed at which these turbines run is too high for maximum propeller efficiency. It is hardly possible that the propeller efficiency exceeds 55 per cent, which means that the actual effective propelling power is only about 38,500 horsepower. At a lower speed of revolution, well within the capabilities of the reduction gear, a propeller could be made that would have an efficiency of not less than 65 per cent. With this improved efficiency, the shaft horsepower required for the same effective propelling power would be somewhat less than 57,000, a saving of almost 15 per cent. This means that without sacrificing in the smallest degree the remarkable speed of these vessels, the boiler equipment could be reduced about one-seventh, as well as the amount of coal burned on each voyage. This would not only result in a very marked saving in capital investment and operating expenses, but would add many tons to the cargo carrying capacity, and add correspondingly to the earning power.

But this estimate, large as it is, is still too modest. With the turbine and the propeller direct connected so that both revolve at the same speed, not only is it necessary to sacrifice the efficiency of the propeller, but the efficiency of the turbine as well.

For equal efficiencies in any two turbines, the number of rows of blades is, roughly speaking, inversely proportional to the squares of the respective peripheral speeds of the rotating elements. The peripheral speed of the rotating elements in the turbines of the Mauretania and Lusitania, is only one-third of the speed common in large turbines used on land. This would mean that to obtain the efficiencies common to the latter, the former would require approximately nine times as many rows of blades, which would make a machine of prohibitive length. To maintain the same speed of revolution and increase the peripheral speed of the turbines of these vessels to the point common in land practice the rotors would have to be nearly 40 ft. in diameter, which is manifestly beyond the shadow of possibility.

Steam Consumption of the Cunarders.

From the best information obtainable, it is believed that the steam consumption of the turbines of the Mauretania and Lusitania cannot be less than 14.5 lb. per shaft horsepower per hour, while it has been demonstrated beyond question that turbines of similar capacity operating at speeds which the reduction gear makes possible for marine service, the steam consumption does not exceed 11 lb. per shaft horsepower per hour. This means that the boiler capacity could be further reduced from the first estimate of 60,000 horsepower to about 45,000 horse-

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power and the overall efficiency of the installation would be sufficiently improved to result in a reduction of over 35 per cent in the coal consumption. It is unofficially reported that the coal consumption of these vessels is about 4,700 tons per voyage. Reckoning the cost of the coal at $3.25 per ton, the saving in coal alone would be $5,300 per voyage, to say nothing of the smaller cost for wages and sustenance for the lesser number of stokers that would be required. The increased cargo capacity resulting not only from a reduction of over 1,600 tons in the coal required to be carried on each voyage, but also from the greatly reduced weight of the equipment, and the space necessary for it, is an asset the value of which it is difficult to over-estimate.

If greater speed would be regarded as more attractive than the possible economies mentioned above, it is easy to see that with the same boiler capacity as is now installed in these ships, the better economy of the high speed turbine would make it practicable to use much more powerful propelling machinery without increasing the amount of coal consumed. The additional power in the turbines, together with the greater propeller efficiency that is possible, would easily give the increased speed that would insure the disembarking of trans-Atlantic passengers on the fifth day with certainty and regularity, instead of only on occasions when all of the conditions are unusually favorable.

The Mauretania and Lusitania have two high pressure and two low pressure turbines, and two reversing turbines working on four shafts. According to the best information obtainable the high pressure turbines have each 128 double rows of blades, and the low pressure turbines 60 double rows each. The total length of the blading exclusive of the relatively small amount in the reversing turbines, is about 115 miles, and the total surface area of the blades is considerably more than three-quarters of an acre, or equal to the sail area of a large ship.

Propulsive Power in Three Turbines.

By using the reduction gear, the same total propulsive power could be installed in three turbines. There is nothing problematical about this statement, as turbines developing the requisite power, and of the same general design as would in connection with the reduction gear be suited to marine work, have been operating successfully for a long time, and their power and economy are now matters of authentic record. Each turbine would have only 51 double rows of blades, a total in the three turbines of 153, or only 25 in excess of the number of rows in one of the high pressure turbines alone in the present installations on board the Cunard flyers. The total length of the blading in the three high speed turbines would be less than 6 per cent of that in the low speed turbines.

Each shaft would be driven by a complete and independent self-contained turbine, and each shaft would have its own reversing turbine so that the entire screw equipment would be available for backing instead of only one-half of it, as is the case in the present arrangement.

However much the new system promises for express steamers in the mercantile marine, it has vastly more important advantages as applied to naval vessels. The express steamer normally runs at its highest speed, and this is the condition for maximum turbine efficiency. This is especially true in the case of turbines connected directly to the propeller shaft, for the reason that as outlined before the peripheral speeds and number of rows of blades are at best below the requirements of efficient design, and any dropping below the maximum working speed accentuates the bad effect of this deficiency.

Cruising Speed of Naval Vessels.

On the other hand, in the case of a battleship or a cruiser, maximum speed is only an emergency condition. The normal cruising speed is only about 60 per cent of the maximum speed, and requires perhaps less than 25 per cent of the maximum power. It is at the cruising speed that turbine propelled naval vessels have shown to disadvantage as compared with vessels propelled by the best types of reciprocating engines. By reason of the more liberal blading that is possible in a high speed turbine, its economic performance is less sensitive to departures from maximum rotative speed, than is that of the low speed turbine. Furthermore, as the entire expansion of the steam takes place in a single turbine, the total power may be distributed conveniently among three entirely independent units, driving one central and two wing propellers. The central unit alone will suffice for ordinary cruising speeds, and can be operated always at somewhere near its most economical conditions of working.

In naval service, the ability to start the turbines when cold, and quickly bring them to full speed may often be of the very highest importance. With turbines directly connected to the propeller shafts, the lengths and diameters of the rotors and casings are such that in order to prevent serious distortion from unequal heating and expansion, it has been found necessary in practice to bring all of the turbine machinery to the normal working temperature before it may safely be set in motion. I have been informed by those having charge of turbine machinery on a large battleship, that the preliminary warming often requires some hours.

Give a Sturdier Construction.

In the double flow turbine which it is proposed to use with the Melville and Macalpine gearing, the smaller dimensions consequent on the higher speeds give a sturdier construction in which the tendency to distortion is reduced to a negligible minimum; and an elastic self-adjusting mounting for the stationary blades, easily removable for examination without unseating the rotor, compensates for any inequality in the expansion of the rotor and the casing, and effectually prevents the stripping of the blades even if there should be actual contact between the stationary blades and the body of the rotor, or between the moving blades and the casing. With this construction, steam, even though it carries large quantities of water of condensation with it, may be admitted to cold turbines, and full speed obtained in less than a minute.

The United States government has lately awarded contracts for two new battleships, to be equipped with steam turbines. These battleships are to have a speed of 20½ knots, which will require in round numbers 28,000 shaft horsepower. With 55 per cent propeller efficiency the effective propelling power will be about 15,400 horsepower. With the 65 per cent propeller efficiency that is easily possible with the reduction gear and a propeller at a lower speed of revolution, this same propelling power would require less than 24,000 horsepower on the shaft. The average steam consumption guaranteed at full power is about 14½ lb. per shaft horsepower. With the better steam economy of the high speed turbine, the boiler capacity required would be reduced fully one third. With the same bunker capacity, the radius of action would be enormously increased, which is an advantage of incalculable value.

If the same boiler equipment as is now proposed were maintained, there would still be a saving in weight of over 250 tons, or approximately one-eighth of the total penalty weight of the machinery in each ship, resulting solely from the substitution of the high speed turbine and reduction gear

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for the more cumbersome slow speed direct connected machine. At the same time, by reason of the well known overload capacity of a liberally proportioned turbine, there would be available a surplus power of about 50 per cent, which should make possible an emergency speed of nearly 3 knots in excess of that called for in the specifications.

Furthermore, the three independent shafts, each with its own self-contained turbines for going ahead and astern, would give the excellent maneuvering qualities which are admittedly lacking in vessels fitted with the present conventional turbine equipment.

I regard this invention as epoch-making in its importance. It has been my privilege to supply—the material things which were needed to transform the creature of Messrs. Melville and Macalpine's imaginations into an actual thing of iron and steel. The results achieved by the completed machine have fully justified my faith in its ultimate success.

GEO. WESTINGHOUSE.

Pittsburg, Oct. 15, 1909.

Experimental Spur-Wheel Reduction-Gear[1]

The inherent desirability of interpolating some form of reduction gear between a marine steam turbine and the propeller it drives has long been sufficiently obvious. Suggestions for effecting this by electrical or hydraulic means have been frequent, and in fact, we hope to illustrate shortly an hydraulic coupling which has given on trial really remarkable results. The straightforward solution of the problem by means of a pinion and a spur wheel has generally been dismissed as impracticable, although the remarkable efficiency of a well constructed toothed wheel drive is known to all. The waste of energy in such a transmission gear is notably less than is commercially practicable with an electric coupling, which in turn is superior in this respect to the hydraulic system. Nevertheless, the fact that turbines of the Laval type were not constructed to transmit more than some 300 horsepower constituted *prima facie* evidence that with higher powers special difficulties were to be feared. The remarkable results obtained with motor car drives, where tooth pressures at times exceed 2,000 lb. per lin. in., were no sure indication that equally good results could be obtained in transmitting by gears some 4,000 horsepower instead of 40, since the rule of three is by no means always applicable in practical constructive engineering. Nevertheless, in his lectures on the steam turbine before the society of arts last spring, Gerald Stoney did suggest that the newer alloy steels and the greater accuracy of workmanship, which have made gearing so successful in motor car practice, did hold out a prospect that the problem of the marine steam turbine might be solved by means of ordinary toothed reduction gearing.

Those interested in steam turbines have known for some months past that a solution of the problem on these lines was, with his characteristic enterprise, being put to a practical test by George Westinghouse, who was having constructed for him a double helical spur gear intended to transmit 6,000 horsepower at 1,500 revolutions of the pinion per minute, the reduction ratio being about 5 to 1. Through the courtesy of Mr. Westinghouse we are now able to publish illustrations of this remarkable experimental gear, the details of which have been worked out by Rear Admiral George W. Melville and John H. Macalpine, who have patented the novel features on which they rely for success. A perspective view of the gear, with the casing partly broken away, is represented in Fig. 1, which shows the device coupled to a Westinghouse double-flow turbine. The forgings for the gears were obtained from Messrs. Krupp, of Essen, the teeth being cut by Messrs. Schuchardt & Schutte, Chemnitz, whilst the standing parts were made by the Westinghouse Machine Co.

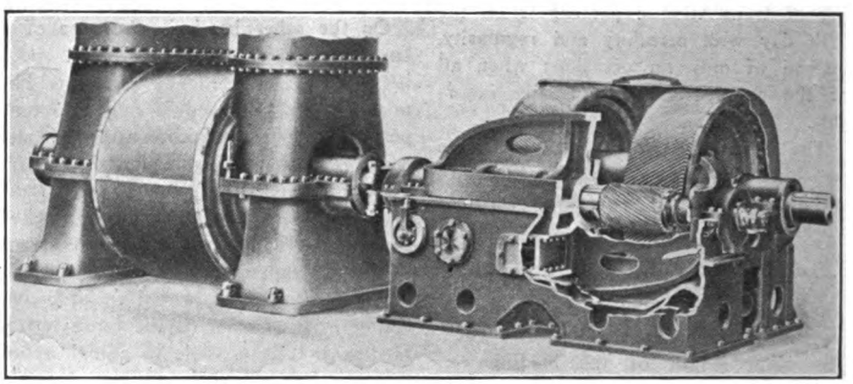

FIG. 1—MELVILLE & MACALPINE'S REDUCTION GEAR CONNECTED TO WESTINGHOUSE TURBINE.

The pinions have 35 teeth each and the spur-wheels 176, a hunting-cog being introduced to equalize wear. The pitch is 1¼ in., and the pitch helices are at an angle of 30 degrees with the axis of the shaft. One wheel and pinion have, of course, right-handed helices, and the other pair left-handed, so as to eliminate end-thrust. The diameter of the pitch circle of the large wheels is about 70 in., and of the pinions 14 in. Details of the gear box are shown in Figs. 2, 3 and 4. These have been designed after a long and comprehensive study of the circumstances which tend to interfere with the proper working of very broad teeth. A small pitch was deemed essential if a reasonable absence of noise was to be secured, and this necessarily meant broad teeth, in view of the fact that 6,000 horsepower was to be transmitted with a pitch-line speed of very nearly 100 ft. per second, and with a limiting pressure of 453 lb. per lineal inch on the teeth.

In order to insure the proper working of such broad teeth, Messrs. Melville and Macalpine have adopted the plan of mounting the pinion shaft in a device which they have dubbed a "floating frame," the object of which is to cause the alignment and position of this shaft to be controlled wholly by the interaction of the teeth in contact, and not by the greater or lesser skill of the workman in laying out and fitting the bearings, which, moreover, even if exactly right to start with, could not be depended on to maintain permanently their alignment. The "floating frame," which is lettered F in Figs. 2 to 4, is a heavy steel casting flexibly mounted in the gear box and supporting in rigid bearings the pinion shaft, but in such a way as to allow of this shaft having a slight longitudinal freedom, so that it can slide axially to and fro within the frame.

Fig. 2 is an elevation of the floating frame showing the flexible I-beams B, on which it is supported from the bed plate. The pinion, it will be seen, is supported in three bearings, the

[1]Reprint from London *Engineering*.

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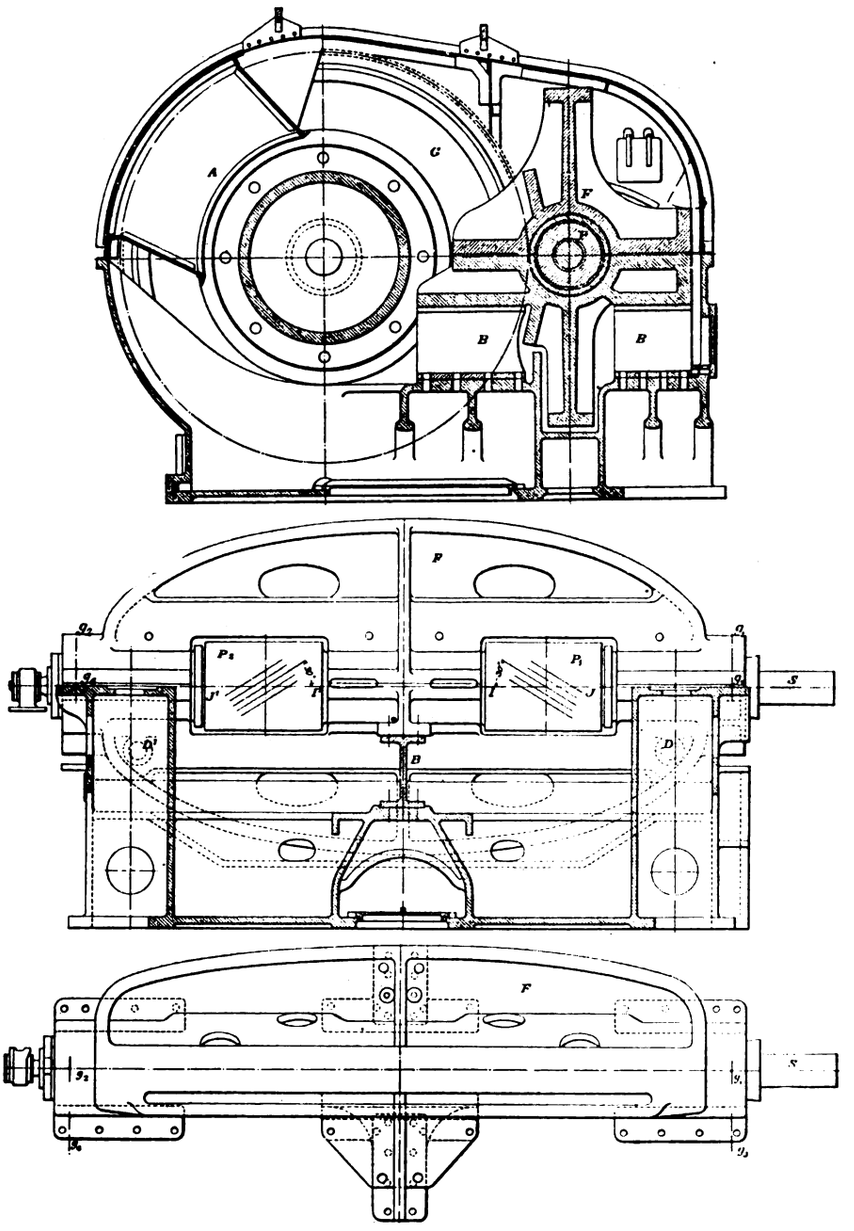

FIGS. 2, 3 AND 4—ELEVATION, PLAN AND CROSS SECTION OF GEAR CASE, SHOWING "FLOATING FRAME."

center bearing dividing the tooth faces P_1 and P_2, of which P_1 is right-handed and P_2 left-handed. The large gear, being much stiffer, requires only two bearings. The floating frame is made very deep vertically, so as to be excedingly stiff to withstand deflection by the nearly vertical forces at the bearings. It is also amply stiffened in the horizontal plane to obviate deflection from the weaker horizontal forces. The floating frame is shown in plan in Fig. 3, whilst Fig. 5, on the following page, shows the pinion shaft and the flexible shaft S by which it is driven. At the end of this shaft is a coupling C driven by the turbine shaft T. The axes of the gear and pinion are horizontal and parallel to one another when everything is in correct adjustment. But it will be evident that the I-beams B are virtually a hinge, and if the large gear G was not in place, or the coupling C connected, the axis of the floating frame and pinion could easily be deflected in the vertical plane through a small angle by a slight flexure of the webs.

The coupling consists of two flanges C_1 and C_2, mounted on the shafts T and S, and connected by two transverse links L_1 and L_2, and by a center pintle, care being taken not to make this restrainst redundant. The shaft T can, therefore, only rotate the shaft S through the links L_1, L_2, but as these are transverse, no longitudinal forces can be transmitted. Even when seriously out of adjustment, the longitudinal forces are so small as to be negligible. The pinion, therefore, has perfect freedom of longitudinal movement in its bearings. Further, the pinion is driven by the shaft S, which passes completely through it to the end distant from the coupling, where it is keyed and bolted. This shaft is so flexible that it imposes practically no constraint on the pinion and floating frame such as would prevent slight angular yield of the I-beams B. It is evident, therefore, that, both as to its longitudinal position in the floating frame and in the angular position of its axis, the pinion is solely under the control of the forces transmitted by the teeth of the large gear.

Neglecting the very slight friction of the well lubricated teeth, the total forces at the tooth contacts, indicated by B, E and B^1, E^1, Fig. 5, will be nearly at right angles to the teeth at B and B^1; that is, they will be at 30 degrees to the vertical. Hence the two parallelograms of forces shown will be similar. Now the horizontal forces at B D, B^1 D^1 are the only axial forces acting on the pinion. If these are not equal, the pinion will at once shift longitudinally, which it is free to do, till they are equal. The two parallelograms of forces then become equal to one another in every respect, and the vertical force B F is equal to the vertical force B^1 F^1. But besides this longitudinal movement of the pinion, the frame in which it is mounted is free to rotate about the center point O by flexing the I-beams. Hence it follows that the moment of the vertical force B F about O must be equal to that of B^1 F^1 about the same point; and as B F = B^1 F^1, the arms of these levers O B and O B^1 must be equal. Thus it is claimed that not only will the total forces on the teeth P^1 and P^2 be equal, but the distribution will be so similar that the centers of pressure B and B^1 will be similarly placed.

This, it is contended, practically assures a good distribution of pressure under all conditions of load. For, by sufficient running of the gear, it may readily be assured for one particular load; and if the pinion and floating frame are made sufficiently stiff, this condition will not be seriously changed by increase or decrease of load. The strength of both pinion and floating frame are far in excess of that requisite to sustain the maximum forces to which they will be

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subject, and their dimensions were made such as to give ample rigidity. For instance, under full load the flexure of the cast-steel floating frame in the vertical plane is so slight that the end bearings will be lowered relatively to the center by not more than 1/2000 in.

There is, moreover, a certain compensation for this deflection, owing to the action of the lubricant. Professor Osborne Reynold's researches on the action of the lubricating films in Beauchamp Tower's well-known experiments on lubrication seem clearly to indicate that at 1,500 revolutions per minute of pinion in the bearings will be well over the present gear the oil-film in 1/1000 in. thick. When the load on the gear is increased, the end-bearings will be forced down, bending the pinion and making the teeth bear harder at the inner ends I and I¹. Thus more than the proper force will be exerted on the center bearing, and less on the outer bearings. This will at once lead to a thinning of the oil-film on the center bearing, and to its thickening on the outer bearings. As the total thickness of the oil-film is more than twice the yield of the outer bearings, this change in the thickness of the film will go far to compensate for the elasticity of the floating frame.

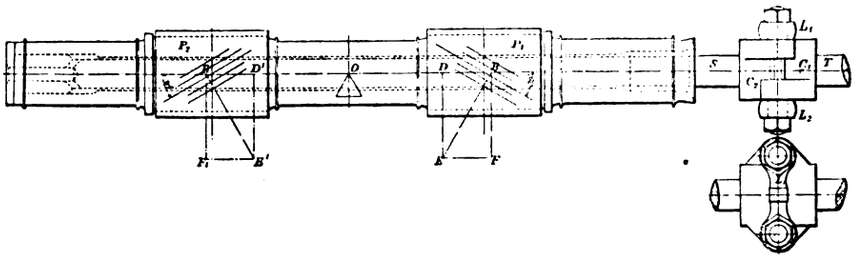

FIG. 5—PINION SHAFT AND FLEXIBLE COUPLING.

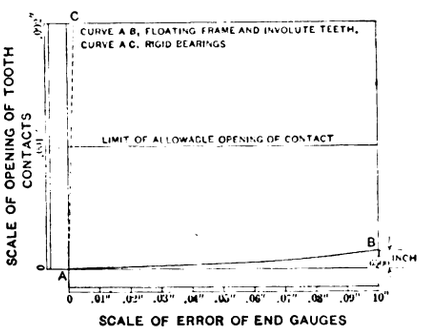
CURVE A B, FLOATING FRAME AND INVOLUTE TEETH.
CURVE A C, RIGID BEARINGS
LIMIT OF ALLOWABLE OPENING OF CONTACT
SCALE OF OPENING OF TOOTH CONTACTS
SCALE OF ERROR OF END GAUGES

FIG. 6.

Given that the axes of the gears are parallel to start with, the action of the teeth will, it is claimed, force the axis of the pinion into exact alignment with that of the large gear, provided that in the flexure of the I-beams supporting the floating frame the pinion shaft tilts in a vertical plane parallel to that containing the axis of the large gear. If there were no floating frame, and all bearings of the pinion and gear were cast in one bed plate, the longitudinal dimensions remaining unchanged, an error of alignment of the axes in the vertical plane not exceeding 1/1000 in. in the length over the bearings would entirely upset the uniform distribution of the pressure along the faces of the teeth. Hence, with the most careful work, the above assumptions may not be fulfilled with sufficient accuracy. Even if they were exactly fulfilled when the gear was first completed, inequality of the side wear of the bearings might cause the axes to stand at a sensible angle in the horizontal plane.

Provision is made for measuring such errors of alignment as follows: Outside the end bearings and both pinion and gear, as shown at g1, g2, g3, g4 in Figs. 2 and 3, there are vertical and horizontal gages placed so that errors of alignment can be readily measured when the gear is running. If the horizontal gages at g3, should show the axes too close by, say, 1/10 in., and those at g4, should show them too open by 1/10 in., giving a total error of alignment of 1/5 in. in length between the gages, it may be shown that, with involute teeth, which are here used, they will bear hard at I and I¹, Fig. 2, and lightly at J and J¹. If the teeth were perfectly rigid, there would of course, be point contacts at I and I¹, and the teeth would actually stand open by a small amount at J and J¹. This opening Messrs. Melville and Macalpine call the "opening of contact."

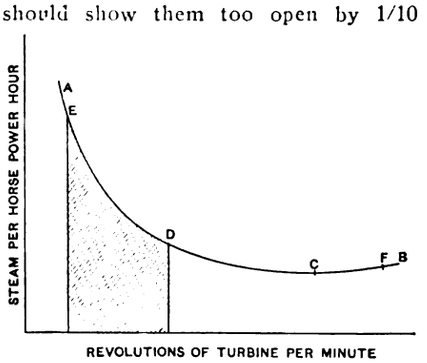

FIG. 7.

If in changing from perfect alignment the pinion turned about either a vertical or a horizontal transverse axis, it may readily be shown that the opening of contact would be a considerable fraction of the sum of the errors shown by the end gages. On the other hand, the inventors state that the action of the floating frame in combination with involute teeth is such as to constrain the pinion to turn about an axis parallel to what is known as the line of action of the teeth—in the present case, an axis inclined 14 deg. 30 min. to the vertical—and this is precisely the movement which reduces the opening of contact to a minimum.

The result is shown in Fig. 6. The error of each end gage is indicated by the horizontal scale, the total length representing 1/10 in., corresponding to a total error of alignment in the horizontal plane of 1/5 in. between the gages, as explained above. The vertical scale shows the "opening of contact" if the teeth are rigid, this scale being enormously magnified, as the quantities to be represented are so small. The curve A B represents the resultant opening of contact for given gage errors for the present gear. The extreme opening of contact shown is 1/6500 in., and this for a gage error which should never be approached. At half this gage error, still large and easily measureable, the opening of contact is reduced to one-quarter of the foregoing, or 1/25000 in., a quantity far below the limit of accuracy of the very finest machining.

Consider next the effects of the elastic strains of the teeth and shafting. Steel gears of 1¼ in. pitch are commonly run under a load of 1,000 lb. per in. of tooth face at ordinary pitch-line speeds. As all gears are liable to errors of alignment, this average pressure actually means that at times there will be a maximum pressure very much greater. In the gear under discussion the highest mean value used is less than 500 lb. per in. of tooth contact. Suppose then that by errors of alignment the actual value varied from zero to 1,000 lb. per in., which is far within the disturbance occurring in ordinary gears. It may be shown that the yield of these teeth under 1,000 lb. per in. is such that the distribution of pressure would close up

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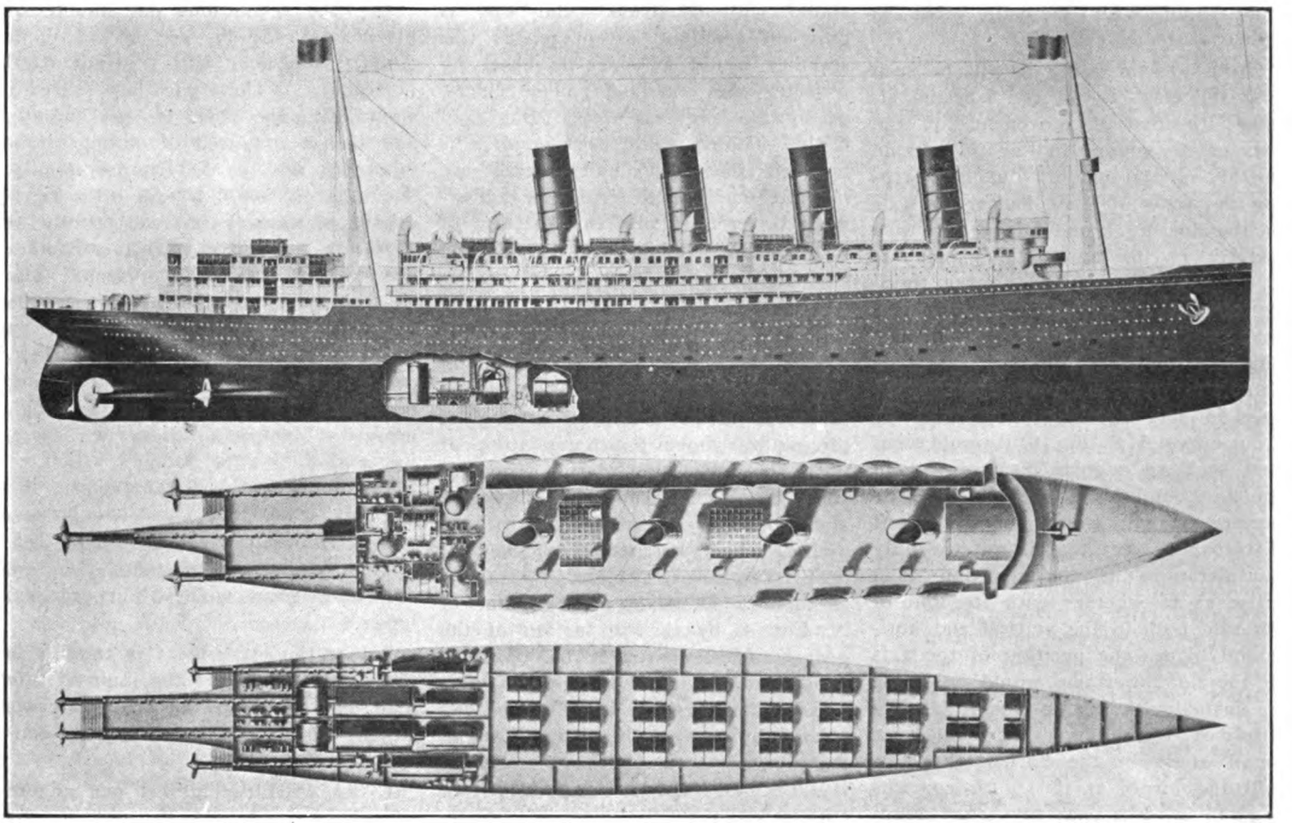

S. S. MAURETANIA AND COMPARISON OF RELATIVE SPACES REQUIRED FOR GEARED AND DIRECT-DRIVING TURBINES.

an opening of contact of nearly 1/1000 in. Thus, even under the extreme gage errors shown at B, Fig. 6. Messrs. Melville and Macalpine claim that the disturbance of distribution of contact pressure is comparatively slight, and at half the gage error stated it would be insensible. They claim, therefore, that gage errors of sensible magnitude do not produce a sensible disturbance. Errors of erection will be exceedingly minute, so that the only errors to be avoided are those due to unequal wear of the bearings. Any unequal vertical wear will be compensated for by slight tilt of the floating frame. As the forces on the floating frame are inclined to the vertical at only a small angle, vertical wear will take place much more quickly than horizontal; and as the inequality of the wear will usually be but a small fraction of the total wear, it would be almost impossible for any very sensible angular error in the horizontal alignment, such as assumed above, to creep in before the bearings were worn down a long way vertically, and ready for renewal. The case they state is very different if the floating frame is dispensed with, and all the bearings are cast in one bedplate. The worst supposition is that there is an error of alignment of the axes in the vertical plane. Keeping all dimensions of the gear and bearings the same as in the gear built, the resulting "opening of contact" is, they find, shown by curve A C, Fig. 6. This exhibits extreme sensitiveness to this error of alignment, as allowable limits will be passed before each vertical gage shows an error of 1/1000 in. Such an error would be so small as to be quite insensible to the eye, and would arise even from strongly screwing down one of the holding-down bolts, or from slight heating of the bearings, and could not be avoided by the most perfect workmanship. Hence the gear with rigid bearings they hold to be quite impracticable.

Involute teeth have been used, as they give the excellent results shown by the curve A B, Fig. 6. But they have also the well known property that if, through wear of the bearings or errors in the original setting up, the axes are somewhat farther apart than designed, the teeth still run true, and there is no "opening of contact." This does not hold with any other form of teeth. For instance, with epicycloidal teeth the action will not be true if the centers move apart, the axes remaining parallel; and in these fine high-speed gears a recession of the centers not exceeding 1/1000 in. would, the designers assert, be quite serious. With this form of teeth also, when the alignment is defective, an opening of contact of 1/1000 in., supposing the teeth rigid, corresponds to an error of each end gage of 1/1000 in.—that is, a total error of alignment between the gages of 1/50 in., which could hardly be detected. Besides, on account of the way in which openings of contacts occur with epicycloidal teeth, the limit of allowable opening of contact is, it is claimed, much under 1/1000 in. Hence this form of tooth is far inferior to the involute on account of its extreme sensitiveness to errors of alignment, and also from the fact that it will not run properly when the axes part even slightly, so that the stresses would be much intensified, and the action of the teeth would be noisy. The curve A B (Fig. 6) is tangential to the base-line at A, while for all other arrangements and forms of teeth the curve of opening of contact cuts this base-line at an angle. Hence the solution presented by the float-

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ing frame with involute teeth is unique.

From the foregoing it will be seen that the elasticity of the I-beams allows freedom of movement of the axis of the pinion and floating frame in the vertical plane. But by warping the webs of these beams the axis of the floating frame might also turn slightly in the horizontal plane. It is, of course, many times more rigidly mounted against this displacement than against that in the vertical plane, but still the rigidity is by no means complete. Now it may appear that this is not specially important, as from curve A B, Fig. 6, it would seem that such an angular displacement in the horizontal plane, even if of measurable amount, causes no important disturbance. But that is not the only consideration, as the question then arose as to whether with freedom of rotation both in the vertical and horizontal planes the position of the axis of the floating frame would be stable or unstable; that is to say, if forcibly displaced from exact alignment to a small angle in the horizontal plane, will the forces at the tooth contacts tend to bring it back to perfect alignment or to further displace it? By consideration of the slight changes of direction of the forces at the tooth contacts produced by such displacement, it can readily be shown that, with involute teeth, the position of the axis of the floating frame is unstable, and a slight displacement arising from any cause will tend to increase. With the I-beams alone, therefore, there might arise excessive horizontal errors of alignment, and trifling causes might produce sudden and violent changes of the horizontal error, either of which effects would endanger the whole mechanism. The floating frame has therefore been deprived of all freedom of motion in the horizontal plane by means of two horizontal struts standing transversely between the floating frame and bedplate. These bear on the floating frame at D and D^1, Fig. 2, and one is clearly shown in Fig. 1. Obviously these struts in no way interfere with the freedom of movement of the floating frame in the vertical plane. Where they bear in the bedplate there is an adjusting and locking mechanism which greatly facilitates the true setting up of the floating frame, and is to be seen in the perspective view in the front of the bedplate, near the end next the turbine.

With epicycloidal teeth in perfect adjustment, the position of the floating frame axis can be shown to be stable without struts. But this is only an apparent advantage, as this stability would at once be upset by widening the gear and pinion centers, or by the slightest wear. But even if this stability could be trusted, it is believed that epicycloidal teeth are far too sensitive to errors of adjustment to be used, and the question of stability or instability in no way affects this consideration.

Provision for Copious Lubrication.

The only condition which could cause serious disturbance of the tooth pressures is an excessive heating of the pinion above the temperature of the gear. But the design provides for a copious application of lubricating and cooling oil, especially to the pinion, which has most tendency to heat. The cover, also, is so arranged as to draw in air at the ends and at A, Fig. 4, by the fan action of the gears, and discharge it by openings (not shown) to the right of this cross-section. Besides, water can be circulated, by means only partly shown in the figures, between the pinion and the flexible shaft S. But it is not anticipated that the heat to be removed per minute will be so great as has been provided for. The gears of heavy electric trains work under much higher stress both in the metal and between the teeth in contact—very much higher, as these stresses are accentuated by errors of alignment shown by rounding of the teeth through wear—and with practically no lubrication. Yet they run for long distances. In the reduction-gear these unfavorable conditions are reversed—there is good lubrication and very uniform contact. If the coefficient of friction at the tooth contacts is 1-10, it can readily be shown that the frictional loss at the teeth will be under 1 per cent. So that even if the gear were transmitting 6,000 horsepower—the very highest power hoped for—this frictional loss would be under 60 horsepower. As at least one-half will go to the large-gear, where it will readily be dissipated from the large surface, there is left well under 30 horsepower to remove from the pinion, which, with the various means provided, should present no difficulty. If then this control of the heat is assured, there will, it is claimed, be practically perfect tooth contacts; this, with the fine pitch and the spiral gears (avoiding sudden entering or leaving contact of one whole tooth at a time), will, it is asserted, insure reasonably quiet running of the gears.

At 1,500 revolutions per minute of pinion and 453 lb. per in. of tooth contact, the gear will transmit 6,000 horsepower. The pitch-line speed would then be 5,500 ft. per minute, and the mean speed of sliding about one-tenth this, or 550 ft. per minute. There is on record a case of a right-angled worm-gear run successfully at 15,000 ft. per minute with a contact pressure of 350 lb. per inch. The average speed of sliding will here be greater than the pitch-line speed by over 41 per cent, or, say, 21,000 ft. per minute. Taking speed of sliding multiplied by pressure as a rough means of comparing these two cases, we get:—

$$\text{Reduction gear} \quad \frac{5{,}500 \times 453}{21{,}000 \times 350} = \frac{1}{29.5}$$

Right-angled worm gear

The extreme constants chosen, therefore, seem well within practical limits.

Before the experiment is tried it is impossible to predict the limit of safe load, but the following are two cases which it will be interesting to consider:—

1. At 1,000 revolutions per minute of pinion, and 283 lb. per in. of tooth contact—that is, as shown above only 28 per cent of the intensity of pressure used with steel gears of 1¼ in. pitch at ordinary pitch-line speeds—the gear would transmit 2,500 horsepower. The famous merchant ship Aberdeen, by the engines of which Dr. Alexander C. Kirk introduced triple-expansion, was about of this power. Her main engines, without shafting, propeller, stern-tube, spare gear and fittings, weighed 221 tons. If we deduct from this the condensers, pipes, sea-valves, air-pumps, circulating pumps, donkey pumps, floors and gratings, etc., the weight left for the main engines proper will be about 150 to 160 tons—say, 150 tons. Hence the following comparison may be made:—

Westinghouse marine turbine of 3,000 brake horse-power, 1,000 revolutions per minute weighs	27	Tons
Reduction gear	25	"
Total	52	"
Aberdeen's engines replaced	150	"
Saving	98	"

That is, 65 per cent of the weight is saved. If this design will transmit 2,500 horsepower, it is claimed that similar gears could be applied

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with great saving of weight and space to all steamships up to 18 knots, which comprise over 95 per cent of all the ships afloat.

2. As already stated, at 1,500 revolutions per minute of pinion, and 453 lb. per in. of tooth contact (or only 45 per cent of the intensity of pressure for similar teeth at ordinary pitch-line speeds), the gear will transmit 6,000 horsepower. If this be realized, similar gears could be applied to any speed of ship. This design would then be of the correct power for the Dreadnought, and applied to her would save fully 50 per cent of the weight of her turbines, besides reducing boiler weights, since both turbines and propellers would now be of considerably enhanced efficiency.

Increasing, by the law of comparison for similar machines, the dimensions and power of the present design, from 6,000 horsepower, a size is obtained suitable for the Mauretania with three large screws of the same total power as the present four-screw ship. Here again the weight of the turbines would, it is claimed, be halved, as also the engine-room length. The boilers also, as in the Dreadnought, would, it is considered, be materially reduced.

In the general plate the upper views represent the Mauretania thus modified, as compared with the existing arrangement shown in the lowest of the three views. For warships the saving effected by such a gear should, it is claimed, be considerable, especially at cruising speeds.

In Fig. 7 is plotted a curve showing the relation between steam consumption and the revolutions of the turbine. The portion of the curve frequently used in marine practice is hatched, and shows clearly how very rapidly the efficiency falls off as the speed diminishes. By using gearing it is contended that the turbine at maximum power can be even slightly over-speeded, as at F, so that at cruising speeds the efficiency will actually be increased.

Admiral Melville on the Tests.

Editor MARINE REVIEW:

Your letter of Oct. 27 is at hand. I have to inform you that the Melville & Macalpine reduction gear has been running at the works of the Westinghouse Machine Co., East Pittsburg for the last month. We had one continuous run of 40 hours of 6,000 H. P. on hydraulic brake. The machine showed an efficiency of 98.4 per cent without heating of bearings or the least abrasion of the teeth. In fact, the lubrication was so perfect that the tool marks still remain in the teeth. The limit of horsepower on the gear was limited by the power of the turbine attached and the power of the boilers which had to be forced to do the amount of work requested of them. The gear has been worked up to 6,750 H. P. without any sign of strain, and we believe the present gear can be worked up to 10,000 H. P. with safety. The experiments are being continued and when tabulated they will be given to the public. I am, sir,

Respectfully,

GEO. W. MELVILLE.

Philadelphia, Oct. 29, 1909.

Proposed New Welland Canal

THE question of enlarging the Welland canal, said the deputy minister of railways and canals for Canada, in a recent report, is passing beyond the stage of mere tentative suggestion, and assuming the position of a need voiced by many practical business men in important cities from Halifax to Vancouver. A large number of resolutions urging the enlargement of the canal have been forwarded to the government in behalf of boards of trade in all parts of the Dominion. These resolutions set forth that the enlargement and improvement of the canal is a matter of the most urgent importance to Canada as a means of reducing the cost of transportation of grain and other export products from the interior to tide water, and also as a means of making the St. Lawrence route the highway not only for the export commerce of the Dominion, but also for that of the central and northern portions of the United States.

At the present time the passage of vessels through the canal is restricted to vessels 255 ft. in length with a beam of 44 ft., although there is a record of a vessel having passed through of a length of 260 ft. and a beam of 43 ft., carrying 2,440 tons of wheat. It is calculated that to make a remunerative voyage from Lake Superior western ports to Lake Ontario eastern ports vessels should be capable of carrying 7,000 to 10,000 tons. The number of locks on the present canal is 25. The points which were taken into consideration by the department in regard to the proposal were: to provide for the passing of vessels up to 600 ft. in length, drawing not less than 22 ft. of water, and the reduction of the number of locks so as to avoid delays in transit. By widening the canal prism to about two and a half times its present width, and increasing its depth to 25 ft., vessels could pass through at two-thirds full speed. The number of lift locks might be reduced to seven; their lift to be 25 ft. This would greatly reduce the normal delays and would also minimize the risk of delay through accident. With these measures of accommodation, it was estimated that the passage through the canal, which now consumes an average of 15 hours in the case of a loaded vessel of full canal size, could be effected in about seven hours.

Upon these estimates, surveys were made for the purpose of ascertaining if it were possible to carry them out. The first result was that it was determined to give up the original idea of enlarging and improving the present canal, and to construct a new one. This new route has been surveyed and a tentative route decided upon. The new line starts from Lake Erie, at Port Colborne, the point of starting of the present canal, and then will proceed in an almost direct line to Fifteen Mile Creek on Lake Ontario, some distance from Port Dalhousie. The route is about seven miles shorter than the present one, and the surveys show that only seven locks will be necessary. The cost of the work is now being estimated in readiness for the early meeting of parliament. While the government proposes to ask parliament to pass an act authorizing the construction of a new Welland Canal, it is not expected that the work will be started for a year or more. The minister of railways and canals stated in a public speech, a few days ago, that there was not any probability that the government would go on with either the Welland or the Georgian bay canals next year.

Following is a list of American freight vessels of the great lakes which cannot pass through the Welland canal:

Name of vessel.		Keel, ft.
Sch.	Abyssinia	288
Str.	Adams, Thomas	360
Str.	Admiral	423
Str.	Adriatic	420
Str.	Albright, John J.	416
Str.	Alpena	356
Str.	Alva	324
Str.	Amazon	376
Str.	Amazonas	295
Str.	Ames, Ward	532
Str.	Andaste	266
Str.	Andrews, M.	532
Sch.	Antrim	366
Str.	Armour, P. D.	264
Str.	Ashley, J. S.	504
Sch.	Athens	293
Str.	Auburn	258
Sch.	Aurora	200

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Name of vessel.	Keel, ft.
Str. Australia	376
Str. Baker, George F.	585
Str. Ball Bros.	480
Str. Ball, Frank C.	530
Str. Barlum, John J	504
Str. Barlum, Thomas	480
Str. Bartow, J. H.	504
Sch. Bell, Sir I. L.	365
Str. Bennington	244
Str. Berry, B. F.	480
Str. Berwind, Harry A.	532
Str. Bessemer, Sir Henry	413
Str. Bethlehem	298
Str. Bielman, C. F.	291
Str. Binghamton	265
Str. Boland, John J.	480
Str. Bope, H. P.	532
Str. Boston	263
Str. Bradley, M. A.	460
Str. Bransford	414
Str. Brazil	276
Str. Briton	296
Str. Brower, A. G.	346
Str. Brown, Fayette	302
Str. Brown, Harvey H.	351
Str. Brown, J. J. H.	432
Str. Brown, W. L.	430
Str. Brown, W. W.	346
Sch. Bryn Mawr	400
Str. Buffalo	381
Str. Buffington, E. J.	580
Str. Bulgaria	280
Str. Bunsen, R. W. E.	446
Str. Burlington	244
Str. Butler, Joseph G.	525
Str. Caldera	504
Str. Caledonia	277
Str. Calumet	420
Str. Cambria	280
Str. Carnegie, Andrew	403
Sch. Carrington	352
Str. Carter, E. D.	504
Str. Case	286
Str. Castalia	364
Str. Centurion	360
Sch. Chattanooga	308
Str. Chemung	308
Str. Chicago	324
Sch. Chickamauga	322
Sch. Chieftain	342
Str. Chili	320
Str. Choctaw	266
Str. Christopher	410
Str. City of Bangor	445
Str. City of Berlin	298
Str. City of Genoa	301
Str. City of London	297
Str. City of Naples	301
Str. City of Paris	298
Str. City of Rome	268
Str. Clarke, E. A. S.	416
Str. Clement, S. M.	480
Str. Clyde	256
Str. Codorus	275
Str. Colgate, James B.	308
Str. Cole, Thomas F.	580
Str. Colonel	356
Str. Commodore	265
Str. Conemaugh	352
Str. Conestoga	252
Sch. Constitution	451
Str. Coralia	413
Str. Corey, W. E.	549
Sch. Corliss, George H.	352
Str. Cornelius, Adam E.	420
Str. Cornell	454
Str. Corona	232
Str. Corrigan, James	530
Str. Corsica	232
Str. Cort, Henry	320
Str. Coulby, Harry	549
Str. Craig, George L.	360
Str. Cranage, Thomas	305
Str. Crescent City	406
Sch. Crete	288
Str. Crete	480
Str. Cuddy, Loftus	525
Str. Cumberland	251
Str. Curry, S. S.	432
Str. Davidson, J. E.	504
Str. Davidson, Thomas	285
Str. Davock, Wm. B.	420
Str. DeGraff, L. S.	585
Str. Denmark	449
Str. Dinkey, Alva C.	580
Str. Donaldson, John A.	380
Str. Duluth	381
Str. Dunham, James S.	420
Str. Dunn, John Jr.	504
Str. Durston, J. F.	432
Str. Eads, James B.	400
Str. Earling, E. J.	525
Str. Eddy, Charles A.	281
Str. Eddy, John F.	259
Str. Eddy, Selwyn	343
Str. Edenborn, William	478
Str. Egan, Wiley M.	252
Str. Elba	420
Str. Ellwood, Isaac L.	478
Str. Elphicke, C. W.	273
Str. Elphicke, Mary C.	430
Str. Empire City	406
Str. England, R. W.	356
Str. Ericsson, John	382
Str. Fairbairn, Sir Wm.	424
Str. Fitch, William F.	346
Str. Fitzgerald, R. P.	256
Str. Fitzgerald, W. E.	420
Str. Flagg, G. A.	318
Str. Fleetwood	265
Str. Flower, Roswell P.	264
Str. Fordney, Joseph W.	344
Str. Foster, Parks	262
Str. French, G. Watson	356
Str. Frick, H. C.	549
Sch. Fritz, John	436
Str. Frontenac	270
Str. Fryer, Robert L.	281
Str. Robert Fulton	414
Str. Gary, E. H.	549
Str. Garretson, Gen.	542
Str. Gates, John W.	478
Str. Gayley, James	416
Str. German	296
Str. Gilbert, W. H.	328
Str. Gilchrist	356
Str. Gilchrist, Frank W.	416
Str. Gilchrist, Joseph C.	416
Str. Gladstone	283
Sch. Golden Age	278
Str. Goodyear, Frank H.	416
Str. Gould, George J.	265
Str. Goulder, H. D.	525
Str. Grammer, G. J.	434
Sch. Granada	247
Str. Gratwick, W. H.	416
Str. Gratwick, William H.	328
Str. Griffin	266
Bge. Grover, M. B.	281
Str. Hand, C. C.	265
Str. Hanna, D. R.	532
Str. Hanna, Howard M. Jr.	480
Str. Hanna, Leonard C.	504
Str. Hanna, M. A.	410
Str. Harlem	288
Str. Hart, Frank W.	380
Sch. Hartnell, George E.	352
Str. Hartwell, Fred G.	504
Str. Harvard	454
Str. Hawgood, A. H.	549
Str. Hawgood, Henry A.	532
Str. Hawgood, H. B.	414
Str. Hawgood, William A.	532
Str. Hebard, Charles	504
Str. Hecker, Frank J.	464
Str. Heffelfinger, F. T.	430
Str. Hemlock	420
Str. Hill, James J.	478
Str. Holden, Hendrick S.	408
Bge. Holley, Alex	361
Str. Holmes, Edwin F.	420
Str. Hoover and Mason	504
Str. Houghton, Douglas	456
Str. Hoyt, James H.	356
Str. Hubbard, Charles	438
Str. Hutchinson, J. T.	346
Str. Ireland, R. L.	416
Str. Iron King	252
Str. Ishpeming	530
Str. Italia	289
Str. Jenkins, Charles O.	504
Str. Jenks, J. M.	414
Sch. Jenney, Wm. LeB.	366
Str. Joliet	266
Str. Jones, B. F.	530
Str. Juniata	340
Str. Jupiter	346
Str. Kearsarge	328
Str. Kennedy, Hugh	532
Str. Kensington	360
Str. Kerr, D. G.	468
Str. Kerr, William B.	585
Str. Kirby, S. R.	294
Str. Kopp, Jacob T.	480
Str. Kotcher, C. W.	420
Bge. Krupp, Alfred	352
Str. La Belle	504
Str. Lackawanna	260
Str. Lagonda	375
Str. Lake Shore	356
Str. Langham	281
Str. Lansing	251
Str. La Salle	266
Str. Laughlin, James	530
Str. Leonard, George B.	380
Str. Lewiston	272
Str. Linn, William R.	400
Str. Livingstone, William	532
Str. Livingstone	281
Str. Louisiana	267
Str. Luzon	346
Str. Lycoming	251
Str. Lynch, Thomas	585
Str. McDougall, Alex	413
Str. McGean, John A.	432
Str. McIntosh, H. P.	520
Str. McKinney, Price	420
Sch. McLachlan, Mary E.	251
Str. McLouth, Sidney C.	266
Str. McWilliams, J. J.	352
Str. Mack, William H.	354
Sch. Magna	352
Sch. Magnetic	264
Str. Mahoning	274
Sch. Maia	376
Sch. Maida	375
Bge. Maitland, Alexander	366
Str. Major	283
Str. Malietoa	454
Sch. Malta	302
Str. Manchester	281
Bge. Manda	352
Sch. Manila	436
Str. Manola	282
Sch. Marcia	302
Str. Maricopa	406
Str. Marina	292
Str. Mariposa	330
Str. Mariska	292
Str. Mars	346
Bge Marsala	436
Bge. Martha	352
Str. Maruba	290
Str. Maryland	316
Str. Masaba	292
Str. Mataafa	429
Sch. Matanzas	324
Str. Mather, Samuel	308
Str. Mather, Samuel	530
Str. Mather, William G.	511
Str. Matoa	290
Str. Mauch Chunk	381
Str. Maunaloa	430
Str. Maytham, Thomas	286
Str. Meacham, D. B.	530
Str. Mecosta	281
Str. Merida	360
Str. Meyer, F. A.	256
Str. Michigan	530
Str. Milinokett	504
Str. Miller, P. P.	354
Str. Mills, Robert	256
Str. Mills, W. M.	585
Str. Milwaukee	325
Str. Minch, Anna C.	380
Str. Minch, Philip	480
Str. Mitchell, Alfred	270
Str. Mitchell, John	420
Str. Mitchell, Samuel	292
Str. Mohawk	292
Str. Moll, Clifford F.	444
Bge. Montezuma	360
Str. Morgan, J. Pierpont	580
Str. Morrell, D. J.	580
Str. Morrow, Joe S.	420
Str. Morse, Jay C.	532
Str. Morse, S. F. B.	456
Str. Mullen, Martin	416
Str. Muncy	350
Str. Munro, Josiah G	530
Str. Murphy, Simon J.	428
Sch. Nasmyth, James	365
Str. Neilson, James B.	308
Str. Neosho	265
Str. Neptune	346
Str. Nettleton, A. E.	525
Str. New York	268
Str. Niagara	266
Str. Nicholas, I. W.	328
Str. Normania	420
Str. North Lake	350
Str. North Sea	350
Str. North Star	350
Str. North Wind	299
Str. Northern King	299
Str. Northern Light	299
Str. Northern Queen	299
Str. Northern Wave	299
Str. Norton, D. Z.	480
Str. Nottingham, William	376
Str. Nyanza	280
Str. Nye, Harold B.	380
Str. Oceanica	262
Str. Odanah	420
Str. Oglebay, E. W.	375
Str. Ohl, Edwin N.	420
Str. Oliver, Henry W.	444
Str. Olympia	276
Bge. 117	285
Bge. 118	285
Bge. 130	292
Bge. 131	292
Bge. 132	292
Bge. 133	292
Bge. 134	292
Bge. 137	345
Str. Onoko	287
Str. Orinoco	295
Str. Orion	269
Str. Orr, Arthur	334
Str. Orr, George N.	326
Str. Osborne, F. M.	380
Str. Owego	325
Str. Owen, John	281
Str. Pabst, Fred	287
Str. Paine, William A.	480
Str. Panay	356
Str. Parks, Sheldon	532
Str. Pathfinder	320

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Name of vessel.	Keel, ft.
Str. Peavey, Frank H.	430
Str. Peavey, George W.	430
Str. Peck, E. M.	252
Str. Penobscot	442
Str. Perkins, G. W.	549
Str. Phipps, Henry	580
Str. Plankinton, John	267
Str. Poe, Gen. O. M.	470
Str. Pollock, W. G.	420
Str. Polynesia	375
Str. Pope, E. C.	317
Str. Pontiac	300
Str. Princeton	451
Str. Progress	255
Str. Queen City	401
Str. Ramapo	319
Str. Ranney, Rufus P	420
Str. Ranney, Rufus P.	247
Str. Rappahannock	308
Str. Ream, Norman B.	580
Str. Reed, J. H.	448
Str. Rees, W. D.	396
Str. Reis, William E.	416
Str. Rend, William P.	287
Str. Renssalaer	454
Str. Republic	364
Str. Reynolds, S. C.	255
Str. Rhodes, Joshua W.	420
Str. Rhodes, Robert R.	246
Str. Richardson, W. C.	354
Str. Riddle, J. Q.	533
Str. Robbins, F. L.	380
Str. Rochester	381
Str. Rockefeller, Frank	366
Sch. Roebling, John A.	436
Str. Rogers, H. H.	580
Str. Rogers, W. A.	525
Str. Roman	296
Str. Rome	265
Str. Roumania	273
Str. Russel, George H.	462
Str. Sacramento	308
Sch. Sagamore	369
Str. Sahara	474
Str. Salt Lake City	532
Sch. Santiago	324
Str. Saranac	290
Str. Saturn	346
Str. Saunders, E. N.	380
Str. Saxon	296
Str. Saxona	416
Str. Schiller, William B.	580
Str. Schlesinger, Ferd	305
Str. Schuck, R. E.	416
Str. Schuylkill	274
Str. Scott, Isaac M.	504
Str. Scranton	260
Str. Scranton, Walter	416
Str. Sellwood, Joseph	523
Str. Senator	410
Str. Seneca	290
Str. Shaughnessey, Sir Thomas	480
Str. Shaw, Howard L.	428
Str. Sheadle, J. H.	530
Str. Shenandoah	308
Str. Shenango	587
Str. Sherwin, John	514
Str. Siemens, Sir William	413
Str. Sierra	438
Str. Sill, Henry S.	416
Str. Sinaloa	416
Sch. Smeaton, John	458
Str. Smith, B. L.	380
Str. Smith, Henry B.	525
Str. Smith, H. W.	414
Str. Smith, Lyman C.	525
Str. Smith, L. C.	414
Str. Smith, M. C.	380
Str. Smith, W. L.	380
Str. Snyder, William P	530
Str. Socapa	504
Str. Sonoma	416
Str. Sonora	346
Str. Squire, F. B.	410
Str. Stackhouse, Powell	504
Str. Stadacona	480
Str. Stanton, John	504
Str. Starrucca	325
Str. Stearn Abraham	525
Str. Steel King	380
Str. Steinbrenner, Henry	420
Str. Stephenson, George	407
Str. Stewart, A. E.	356
Str. Stone, Amasa	525
Str. Stone, George	270
Str. Sullivan, J. J.	532
Str. Sultana	362
Str. Superior	382
Str. Superior City	429
Str. Susquehanna	302
Str. Sylvania	504
Str. Syracuse	267
Str. Tacoma	267
Str. Tampa	291
Str. Taylor, Moses	416
Sch. Thomas, Sidney G.	366
Str. Thompson, Alexis W.	504
Sch. Thompson, A. W.	300
Str. Thompson, Smith	438
Str. Tioga	285
Str. Tionesta	340
Str. Tomlinson, G. A.	504
Str. Tower, C., Jr.	255
Str. Townsend, Edw. Y.	580
Str. Trevor, John B.	308
Str. Troy	398
Str. Truesdale, William H.	432
Str. Tuscarora	291
Sch. Tyrone	300
Str. Uganda	291
Str. Umbria	420
Str. Upson, Andrew S.	380
Str. Upson, J. E.	504
Str. Uranus	346
Str. Utica	325
Str. Vance, Frank L.	257
Str. Van Hise, Charles	446
Str. Venezuela	263
Str. Venus	346
Str. Vermillion	252
Str. Verona	480
Str. Victory	450
Str. Volunteer	270
Str. Vulcan	260
Str. Wade, J. H.	265
Str. Wainwright	420
Str. Waldo, L. C.	450
Str. Walker, Perry G.	416
Str. Wallace, E. L.	420
Str. Wallace, J. C.	532
Str. Wallula	260
Str. Walsh, James P.	480
Str. Warner, Charles M.	370
Str. Warner, R. S.	318
Sch. Warriner, S. D.	300
Str. Watson, C. W.	380
Str. Watt, James	405
Str. Wawatam	266
Str. Weeks, J. L.	416
Str. Wells, Frederick B.	430
Str. Western Star	416
Str. Weston, Charles A.	549
Str. White, Peter	504
Str. White, Pendennis	416
Str. Whitney, D. M.	412
Str. Wickwire, Theodore H.	444
Str. Widener, P. A. B.	580
Str. Widlar, Francis	416
Str. Wilkesbarre	381
Str. Williams, George F.	280
Str. Wilpen	554
Str. Wilson, Capt. Thos.	416
Str. Winnipeg	252
Str. Wisconsin	420
Str. Wissahickon	350
Str. Wolf, William H.	504
Str. Wolf, William H.	285
Str. Wolvin, Augustus B.	540
Str. Wood, James B.	514
Str. Woodford, W. R.	532
Str. Woodruff, Louis	416
Str. Wright, Alfred P.	286
Str. Yonkers	264
Str. Yosemite	356
Str. Yuma	332
Str. Zenith City	387
Str. Zimmerman, Eugene	480

Building Ocean-Going Vessels in Canada

THE question of establishing shipbuilding yards in Canada for the construction of steel ocean-going vessels of the largest class, and the construction of dry docks for the repair of such vessels, on both the Atlantic and Pacific coasts, is attracting considerable attention in the Dominion and in Great Britain at the present time. The increasing number and size of the vessels frequenting the ports on both oceans is bringing into prominence the great lack of facilities at present existing for the repair of vessels, and the present political situation in Europe has something to do with the anxiety of British ship builders to provide themselves with yards far removed from the anticipated scene of probable warfare.

So far as the dry dock situation is concerned there are three docks in Canada capable of accommodating large ocean-going vessels. They are: The government dock at Halifax, N. S.; the Davie dock at Levis, Que.; and the government dock at Esquimalt, B. C. To these might be added the Reid dock at St. Johns, Nfld. The Halifax dock is scarcely used for commercial vessels, so that the only available dock in Canada, for vessels engaged in the trans-Atlantic trade, is that at Levis. During the financial year ended March 31, 1908, this dock was occupied for 260 days by 26 vessels of 43,162 tons. Of these vessels, the largest were the Allan liner Corinthian, 6,227 tons, and the Dominion liner Ottawa (formerly Germanic) 5,071 tons. The Esquimalt dock was occupied during the same period for 158 days by 24 vessels, the largest of which were Suveric, 6,585 tons; Admiral Exelmans, 6,029 tons; Indravelli, 5,805 tons; Fukui Maru, 5,339 tons. In regard to the dock at Esquimalt, it being a government one, the Canadian and the British governments have a prior claim to place their vessels in it, therefore its usefulness for commercial vessels is restricted. Its situation on Vancouver island, away from Victoria and Vancouver, where the commercial vessels arrive and depart, however advantageous it may be for naval purposes, is not altogether convenient for commercial vessels.

Annual Subsidy of 3 Per Cent.

In 1903 the Dominion government passed an act whereby an annual subsidy of 3 per cent for a period of 20 years on the cost of a dry dock not to exceed $1,000,000 might be paid to any company constructing a dry dock in accordance with plans first submitted to and approved by the department of public works. During the session of 1908-9 an amending act was passed making such subsidy payable on a sum not exceeding $1,500,000. The first and only company to take advantage of the provisions of this act was the Vancouver Dry Dock & Ship Building Co., with which the department of public works entered into an agreement May 31 last for the construction of a floating dock in the harbor of Vancouver, having a length of 486 ft. by 66 ft. in width, with a tonnage of 11,000. This dock will be constructed in England by Swan & Hunter, Newcastle-on-Tyne, and shipped in knockdown condition to Vancouver.

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For many years past, efforts have been made in St. John, N. B., to secure the construction of a dry dock there. The Imperial Dry Dock Co. was incorporated by the New Brunswick legislature, and subsidies were voted by legislature and by the city of St. John. The Dominion subsidy, under the dry docks' act already mentioned, was also available, but nothing has been done and the proposal still remains a paper one.

The Present Proposal.

A proposition has been made to the Dominion government by the ocean marine interests of Canada for the construction of dry docks and ship repairing plants at St. John, N. B., and Levis, Que. Those forming the deputation, which recently waited on the government, are connected as owners or managers with all the lines of ocean-going steamers trading to and from Canadian ports. Over a dozen of the steamers in the lines represented are too large to enter the existing docks. The deputation asked the government to recommend parliament to sanction the further amendment of the dry docks act so that a subsidy of 4 per cent on the capital cost of these two docks would be payable by the government for a space of 50 years. W. Dobell, Quebec, in outlining the proposition stated that dry docks as such did not as a rule pay, but in this case a provisional company had been formed with a capital of $1,000,000 subject to the 4 per cent subsidy for 50 years being given by the government. The proposal was to establish docks at Levis and St. John, the dock at the former point to be 1,000 ft. long with a width of 104 ft., and the dock at the latter point to have a length of 800 ft., width 130 ft., and gate 100 ft. The Levis dock would cost, it was estimated, $3,500,000 and that at St. John $2,500,000, and three years would be occupied in their construction. An essential feature of the proposal was the purchase of the Davie dock at Levis, in order to provide accommodation during construction and then to take care of the smaller vessels. The premier promised that the matter would receive the greatest consideration from the government.

The Dry Dock Proposition.

In connection with this matter it is of interest to note that an application will be made next session of the Dominion parliament for an act incorporating a company with the title of the Dominion Dry Dock & Ship Building Co. to carry on the business of ship builders, owners of dry docks and various other allied businesses. The capital of the company is $1,000,000 and the offices are at Montreal.

This dry dock proposition, while it has a bearing on the ship building proposition, is not directly connected with it. The ship owners are interested primarily in having facilities provided for the proper repair of their vessels. The question of establishing yards for the construction of ocean going steel vessels has also been before the country for some years. In 1901 the question was very much discussed in Nova Scotia, and in that year the Provincial legislature voted a subsidy of $100,000 payable to the first company establishing a yard in the province capable of building five steamers of a capacity of 5,000 tons each, and providing that municipalities may, under certain conditions grant a bonus of a similar amount. Under a local act Halifax has power to give a bonus of $200,000, and Dartmouth took power to vote $100,000 for a yard on Halifax harbor, while Sydney took power to give a subsidy of $250,000 to aid in starting a yard there. The general act also provides that iron or steel vessels built and registered in Nova Scotia shall be exempt from all taxation in the province. The only step that has been taken to earn any of these subsidies is the purchase of a site at Dartmouth by a company of which Swan and Hunter are shareholders, and the holding of it for use as a ship building yard. The Armstrong and the Furniss firms looked into the prospects of Canada as a field for the establishment of branch yards about the same time, but they decided not to do anything. The principal feature which makes the situation different today from what it was then, is the fear of a descent of the German navy on the British coast and the consequent danger to the building and repairing plants there; and the fact that Canada has in contemplation the building of a navy. The construction of one or more yards in Canada will provide, not only a yard for the building of all the vessels needed for a Canadian navy, but will form a place of repair for British vessels away from any point of danger in the event of hostilities on the North sea. The Swan and Hunter firm has already an interest in the site of a yard in Halifax harbor, and as this firm has already done considerable work for the British navy, it would appear to be the most likely firm to locate in Canada, and that Halifax will be selected as the site of the plant. On the other hand it is stated that Levis is a much more suitable point for a plant which will involve the construction of naval vessels. In connection with the establishment of a yard at this point the firm of Harland & Wolff, Belfast, Ireland, is mentioned. This firm has the general contract for the building and repair of all steamers of the various lines of the International Mercantile Marine Co., and as the Dominion and the Dominion-White Star lines trade to Canadian ports, it is not at all unlikely that it would take steps to have a yard in Canada. The firm has never gone in for building men-of-war, principally on account of the lack of suitable dock facilities at Belfast, but in 1889 it built the torpedo depot ship Vulcan, and in 1898 the engines for the battleship Hannibal.

Action of Government Uncertain.

It is impossible to say what will be done, as everything depends upon the action of the government. If the 4 per cent subsidy for 50 years be voted it is almost certain that both dry docks and ship building yards will be gone on with, but if the subsidy is not given, or only in part, it is doubtful if the ship building proposal will be gone on with at all. As Harland & Wolff could not undertake any contracts for men-of-war for the British navy, because the Alexandra dock was not wide enough to permit their construction, so it is equally certain that the British ship building firms will not start yards in Canada unless the most ample dry dock facilities are previously provided. Canada has been subsidizing the railway interests very heavily of recent years, and the marine men are of opinion that they ought to receive the same generous aid towards building up their interests.

CHICAGO NAUTICAL SCHOOL.

The Chicago Nautical School, which has gained a merited place among the thriving schools of the west, announces the beginning of the fourteenth year of its work. This school was started in a modest way at the request of a number of young men who were anxious to gain a better knowledge of the principles of navigation and marine engineering and who could not leave their occupation to attend a regular college. From this small beginning the school has grown into a recognized factor in the educational schools for the teaching of practical knowledge.

The work is carried on either by correspondence or by personal instruction as the student may elect, and he is led along, step by step, over the very ground that his practice will lead him in his future work.

The course in marine engineering is under the charge of J. E. Stedman, a marine engineer of years of practical experience on the lakes.

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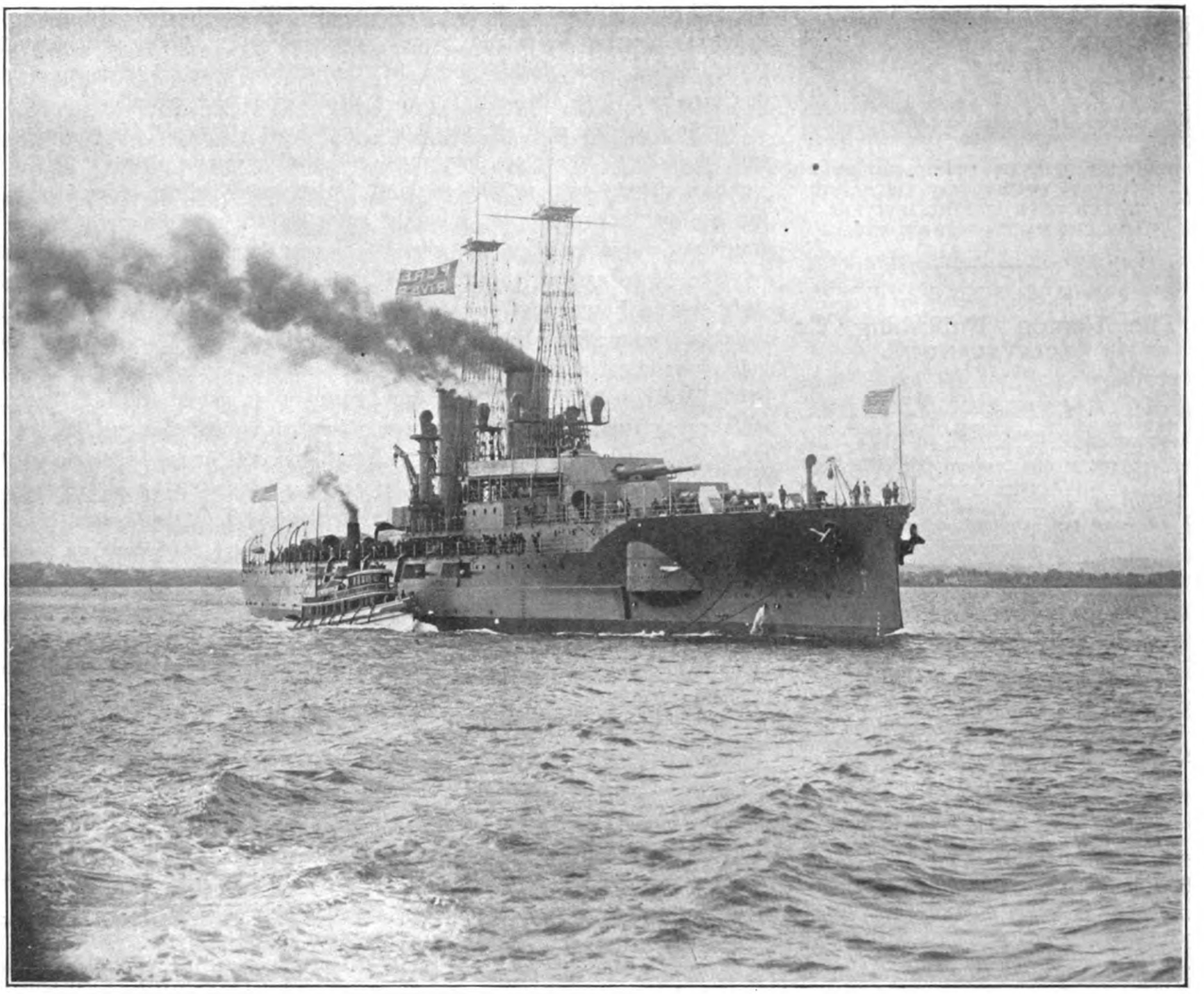

BATTLESHIP NORTH DAKOTA LEAVING THE FORE RIVER YARD.

NORTH DAKOTA THE FASTEST BATTLESHIP.

The battleship North Dakota underwent her trials Nov. 3 and 4 and proved herself to be the fastest of her type afloat. On her standardization trial she developed a maximum speed of 22.25 knots and an average speed during five runs of 21.83 knots. Her maximum brake horsepower was 35,150, her average power 33,875. The power necessary to drive her 21 knots is 25,600 at 263 revolutions per minute. After leaving the Fore river yard she was taken to the Boston navy yard where her bottom was cleaned and painted and a set of Monel metal propellers fitted in place of the manganese.

The North Dakota's sister ship, the Delaware, underwent her trials on Oct. 23, attaining a maximum speed of 21.98 knots. The comparisons between the trial performances of the North Dakota and Delaware are as follows:

	North Dakota.	Delaware.
Fastest speed	22.25	21.98
Mean speed	21.833	21.44
Best horsepower	35,150	30,000
Mean horsepower	33,875	28,578

NEW FLOATING DOCK.

A contract for a floating dock for dealing with Brazilian Dreadnoughts has been awarded by the Brazilian government to Messrs. Vickers Sons & Maxim, Limited, Barrow-in-Furness. The dock will be of Messrs. Clark and Standfield's double-sided self-docking type, having a length of 550 ft. 6 in., a clear entrance width of 100 ft., and a depth of 31 ft. The dock will consist of a pontoon and two parallel side walls, and the whole will be divided into three sections. The center section of the pontoon will have a length of 165 ft., and the two end sections a length of 170 ft. each, their outer extremities being built in the form of a point or bow. The engine deck, on which will be placed the boilers, engines, dynamos, and pumping machinery, will be about 20 ft. below the top deck of the walls, while above the engine deck there will be cooking and other accommodation for 700 men and officers of any ship. The dock will have a lifting power of 22,000 tons, and the pumping machinery and other engines will consist of two identical installations, one in each wall. The plant in each wall will consist of three boilers and three engines and pumps, one in each section. Tenders were submitted to the Brazilian government by three British, one American, one French, and three German firms.

James Tregarthen & Son, New York, have awarded a contract to Robert Palmer & Son Co., of Noank, Conn., for a drydock which will be 161 ft. long with two out-riggers each 35 ft. long. The same company have also received contract for a steamer 166 ft. long for service between New York and Ellis island.

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ANOTHER FOREIGN SHIP FOR AMERICAN BUSINESS.

Elsewhere in this issue we print an article describing and illustrating another splended modern steamship flying a foreign flag although built for business generated wholly within the United States. This vessel—the H. C. Henry—is owned entirely by American capital.

Under existing laws and in the face of severe competition by foreign, subsidized steamship lines it was impossible for this ship to be built in the United States and operated under the American flag although her owners are patriotic American citizens. They would have liked to have built the H. C. Henry at home and to operate her under the stars and stripes. But this is financially impossible under existing circumstances.

What we said in the September issue of THE MARINE REVIEW regarding the Chicago, Milwaukee & St. Paul steamers Tacoma Maru and Seattle Maru applies with double force in this instance.

Not only do we give all our shipping business to foreigners, but when our own citizens want to build a ship for use in the service of a purely American enterprise they are forced to take their capital abroad, build their ship in Europe and operate her under a foreign flag. Every ship so built and operated makes it just so much harder to build up an American merchant marine, when we do get ready to commence this task.

How long will this idiocy continue? How long are we going to be willing to pour money into the coffers of foreign shipowners and drive our own shipbuilding capital away? Some day our Congress will wake up. We earnestly hope it will be soon, before it is too late.

THE NAVY VS. THE MERCHANT MARINE.

Every time that Beekman Winthrop, assistant secretary of the navy, talks on the subject of the navy vs. the merchant marine, he makes the case worse. During his recent visit to the Pacific coast he gave out a number of interviews with the apparent intention of lessening the feeling which exists on the Pacific coast against the chartering of foreign steamships for carrying coal. The Pacific coast has a just grievance, for the foreign tramps have certainly demoralized its shipping. Winthrop, in his defense, instead of justifying the act, makes it more indefensible.

Among many things he said:

> The chartering of those foreign steamships to carry coal between American ports is not a violation of the coastwise navigation laws. We were informed by the attorney general that the coastwise navigation laws did not contemplate such a condition, so we chartered the vessels. I do not wish to be understood as saying that the navy department favors the employment of foreign vessels in preference to American bottoms. We, as a matter of fact, wish to employ American vessels preferably. The navy department is dependable upon the merchant marine and naturally desirous in every way to encourage it.

There is a contradiction of statement in this paragraph. If the navy department preferred American bottoms why did it find it necessary to go to the attorney general for an opinion which permitted it to employ foreign ships? The only way the navy department can indicate preference for the merchant marine is to employ it upon all occasions and regardless of all circumstances. It would pay to do so, as we shall presently show.

What does Winthrop mean by the statement that the navy department is dependable upon the merchant marine? How can it be dependent upon a merchant marine which does not exist? Is he aware that that old sea dog, Rear Admiral Evans, has publicly boasted that the navy department is independent of the merchant marine, and that two days at sea will give the greenest land-lubber his sea legs. It might be well to publish for the benefit of the boastful old man the statistics of seasickness on the battleship fleet, for it is reliably reported that frequently in wild weather nearly one-half of the crews were sick. The galling thing is that there is absolutely no sincerity to be met with anywhere in the navy department in its attitude toward the merchant marine.

Again Winthrop says:

> The employment of foreign colliers in the case was an emergency matter. We had to transport the coal from one coast to the other within a certain time and even if the available sailing vessels had offered a rate as low as that of the foreign tramps we could not have moved our coal in the required time. We were allowed to offer them a rate of 50 per cent higher than the foreign bid and would have been willing to go even higher, but they could not have moved the coal as quickly as we desired.

Apparently it is impossible for Winthrop to be candid. Whatever emergency may have existed on the battleship cruise, certainly no such emergency existed during the present year. Time was not an asset and American ships could have moved the coal as well as not. Moreover, the rate of 50 per cent higher was purely arbitrary. If it could be fixed at 50 per cent it could be fixed at 75 per cent or as much more as was needful to meet the ship's operating expenses.

But the prize sentence of all is this:

> Now that the emergency coal shipments are out of the way, we are endeavoring to patronize American ships, and I may say we are offering them a rate which is in excess of the 50 per cent bonus recommended by President Roosevelt.

Why doesn't Winthrop come out flatly and say now that the navy department has no more coal to ship it is endeavoring to patronize American ships at a rate in excess of what it was willing to pay when it had coal to ship?

Let us prove that it is national econ-

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omy to charter American ships at $7 per ton as against foreign ones for $3.50. To begin with the navy department moves annually to the Pacific coast about 170,000 tons of coal. This would make 30 cargoes of 5,660 tons each, an average somewhat high, and each ship would make three round voyages per year. It would therefore require ten ships to handle this coal. Let us now assume that these ships are to be built for the trade and that they will cost $60 per ton of carrying capacity. This is the sum that the navy department is now paying for the 12-knot colliers building for it. Ten ships would therefore cost $3,395,000. These twin-screw government colliers will carry a crew of 60 men, but in ordinary commercial practice and with single screw machinery a crew of 40 men would be sufficient. Their average rate of pay, including officers, based upon wages now paid in the merchant service, would be about $60 a month. Of the construction cost of $3,396,000 about $1,867,000 represents material and $1,529,000 ship yard labor. Of the material account fully 50 per cent represents labor. It is therefore reasonable to assume that the creation of this fleet would put the following sums in circulation in one year: Profit on material, 10 per cent, $186,780; ship yard wages, $1,529,000; material labor, 50 per cent, $933,900; wages, crews, $288,000; profits on supplies (20 per cent of subsistence 400 men at 50 cents a day), $14,600; supplies labor, 50 per cent (labor producing supplies), $36,500; maintenance (repairs, etc.), 8 per cent of total value, $271,680; total, $3,260,460.

Now there is no possibility of evading this showing. It is exactly what would occur were this American fleet created. In carrying the coal in foreign bottoms at $3.50 per ton as against $7 asked by American ships, the navy department has saved $595,000, but it has curtailed American business, almost entirely labor, to the extent of $2,665,460. Thus the country saves less than $600,000 per year by the action of the navy department and loses for one year $2,665,000 to the country at large, and in addition pays nearly $600,000 for the upkeep of foreign ships.

Nor is this all. When the effort was made to extend the coastwise laws to embrace the Philippines the supplies for the army and navy were exempted from its provision. Even had the coastwise laws been extended these supplies would continue to go abroad in foreign ships, as they are now doing. The army is just as bad as the navy when it comes to rendering real assistance to the merchant marine. Why in the name of heaven can't their supplies be carried in American ships when it is so clearly to the interest of the whole country to have them do so? It would not be losing money to the country. It would be making money.

But the end is not yet. The government is transporting hundreds of thousands of tons of all manner of freight to the canal zone, which is American territory by right of purchase, but the coastwise laws, which should be rigidly enforced here, are suspended and the stuff is being dumped on the Isthmus from foreign bottoms. Consider for a moment what colossal folly this is. If this trade were reserved for American ships it would create at once a fleet sufficiently capacious to care for all coal requirements of the navy and forever put a stop to its endless chatter that it cannot get American ships when it wants them. It would stimulate industry marvelously and would pour into circulation continually far more money than can possibly be saved by employing foreign ships.

It is utterly absurd to maintain a fiscal policy which enables our factories to manufacture the products for the canal zone but prevents our ships from carrying them there. The blessings of protection should be horizontal.

INLAND RIVER NAVIGATION.

The inland river navigation of the United States may be said to have lain dormant ever since the railway was developed as a freight carrier, the notable example being the mighty Mississippi and its great tributaries. In this network of waterways there undoubtedly lies great potentiality of public service. Especial interest is therefore lent to a corporation recently organized by prominent men in St. Louis, the prime mover being W. K. Kavanaugh of St. Louis, president of the Lakes to the Gulf Deep Waterways Association, for the utilization of the Mississippi and its tributaries without waiting for the creation of the deep channels which have been so long advocated. This company is called the Mississippi Valley Transportation Co. Apparently the company intends to make a real effort to develop fully the present resources of the river upon the most modern lines. There is no intention to return to the old steamboat methods of the ante-bellum days, but rather to substitute fleets of barges and tow boats adapted to the varying conditions of the river, for instance, barges capable of carrying 1,000 tons on 4 ft. of water on the upper Mississippi, and of loading 4,000 tons on 8 ft. draught on the lower Mississippi; also light steel barges capable of carrying 800 tons on 3 ft. of water out of Pittsburg during the low water season; snag-proof armor clads for the wheat of the upper Missouri and other barges for the lock channels of the Cumberland and Tennessee. The tow boats are to have sufficient power to move a fleet of barges carrying 20,000 tons down stream and from 6,000 to 8,000 tons up stream. These will connect with coast steamers at New Orleans to care for the trade of the West Indies, Central America and Mexico. Loading and unloading will be by means of the most modern machinery.

The United States government has already expended over $200,000,000 in river and harbor improvements. The Mississippi Valley Transportation Co. is going on the theory that the quickest way to secure deeper channels is to employ those that actually exist. Doubtless the present channels are ample for a very large commerce. The Mississippi has from four to five feet of water in the channel at low water from St. Paul to St. Louis. The Missouri has 45 ft. from Kansas City to St. Louis. The Ohio has, except at extreme low stages, an equal depth from Pittsburg to Cairo, and even in a drought, about 3 ft. The Mississippi from St Louis to Cairo has usually 8 ft.. and always 5 ft. and from Cairo to New Orleans never less than 9 ft. For 120 days of the year ves-

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sels drawing 14 ft. of water could run from St. Louis to New Orleans. It is well known that the battleship Mississippi ascended the river to Natchez during the present year.

Apparently the Mississippi Valley Transportation Co. is profiting by the example of Europe. The Rhine, on a depth of 9 ft. on its lower reaches and 3 ft. on the upper, carries 45,000,000 tons of freight a year. The Elbe on a depth of 6 ft. above Hamburg and 4 ft. in Saxony and Bohemia carried 20,000,000 tons of freight a year. The Oder at its upper end at Breslau and Kosel carries annually 3,500,000 tons of freight on a draught of only 30 in. This little stream carries more traffic than the entire Mississippi through the employment of modern barges and tow boats and efficient terminal handling apparatus.

It is well known that one of the great obstacles to the success of the old packet boats in the river was the lack of facilities for promptly handling freight. The negro roustabout supplied it all, and he was frequently useless or nearly so. The purpose is to establish cranes at the principal landing places for swinging freight from the barges into the warehouses or freight cars and to erect sheds for storage with every facility for the safe and economic transfer of cargo.

The plans appear to be well thought out and the project is certainly backed by some of the most successful, influential and progressive men of the west. If adequate transportation facilities are provided there can be little doubt of patronage. Much freight that is now dragged by the railways over the hills to the seaboard will find a more natural outlet through the rivers. The progress of the enterprise will be watched with interest.

Captain R. Jollie of the steamer E. J. Buffington reports to the Cleveland branch hydrographic office that the conical gas buoy marking the upper entrance to the downbound channel through the St. Clair Flats canal is not burning very brightly and can scarcely be seen 200 ft. in clear weather. Also that the red light on the end of the breakwater at Two Harbors shows very dimly and cannot be seen at all in thick weather.

New Ship Yard at Ashtabula

HEREWITH is published the plan of the new ship yard which the Great Lakes Engineering Works of Detroit will establish at Ashtabula, the citizens of Ashtabula by a vote of 2,916 to 44 having authorized the bonding of the city in the sum of $390,000 to improve the river for the purpose of making the site available. The site was donated to the company by the city after it had been secured from the Pennsylvania company, in exchange for Point park. Point park is located on a hill in a direct line with the Pennsylvania company's lake front docks. The Pennsylvania company is now leveling the hill with a steam shovel in order that more tracks may be laid to its docks on the lake front. The relative location of docks and ship yard are clearly shown in the accompanying sketch, Fig. 1, the dotted line representing the amount of dredging that the city must do for the accommodation of the ship yard.

It will be seen from the general plan of the proposed ship yard, Fig. 2, that the Great Lakes Engineering Works has in mind the establishment of a plant of a modern and capacious character. Two dry docks, each 650 ft. long by 100 ft. wide, will be arranged side by side and served by a complete track and crane system. The docks will be of reinforced concrete construction and the pumping plant will be of the latest type, equipped with 36-in. centrifugal pumps. A great turning basin will be dredged directly in front of the docks capable of winding the largest of lake craft. The ship yard proper has a large water frontage as shown on the plans. The building berths run parallel to the Ashtabula river, which will be made 175 ft. wide in front of the building berths. Boats will be launched into the river. The company will do away with the usual type of shear legs and will adopt the tower crane system as now used in some English, German and Italian ship yards.

Reference to the drawings will show that study has been given to the economy of handling material. All buildings and departments are arranged most conveniently and the system of railroad and yard tracks is comprehensive. Material entering the yard will move always in one direction until it is landed on the building berths. The yard tracks will be served by the usual heavy type of locomotive cranes.

During the past few years the port of Ashtabula has undergone great development. To understand how great this is it is only necessary to recall the changes that have taken place within the last few years. It has become unquestionably one of the most strategic points for a ship yard on the whole chain of lakes. From a small beginning the port of Ashtabula has been gradually developed by the Lake Shore & Michigan Southern and Pennsylvania companies, the former operating wholly on the east side of the river in the harbor territory and the Pennsylvania on the west side. The Lake Shore developments have been

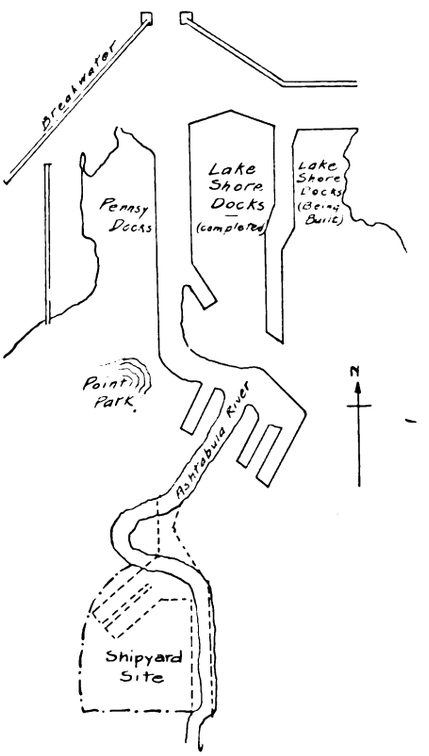

FIG. 1—PLAN OF HARBOR.

much heavier than those of the Pennsylvania, presumably because the latter company has access to other ports such as Erie, Cleveland, Sandusky and Toledo, while the Lake Shore has concentrated its lake business at Ashtabula alone.

The first development of Ashtabula harbor was for handling coal from the Pittsburg district by dredging out the so-called river, merely a creek, from its mouth inland sufficient for the vessels then sailing to get to the docks.

The loading of coal in the early days was accomplished by means of large buckets or tubs, holding from two to three tons each, and revolving cranes which handled the tubs from

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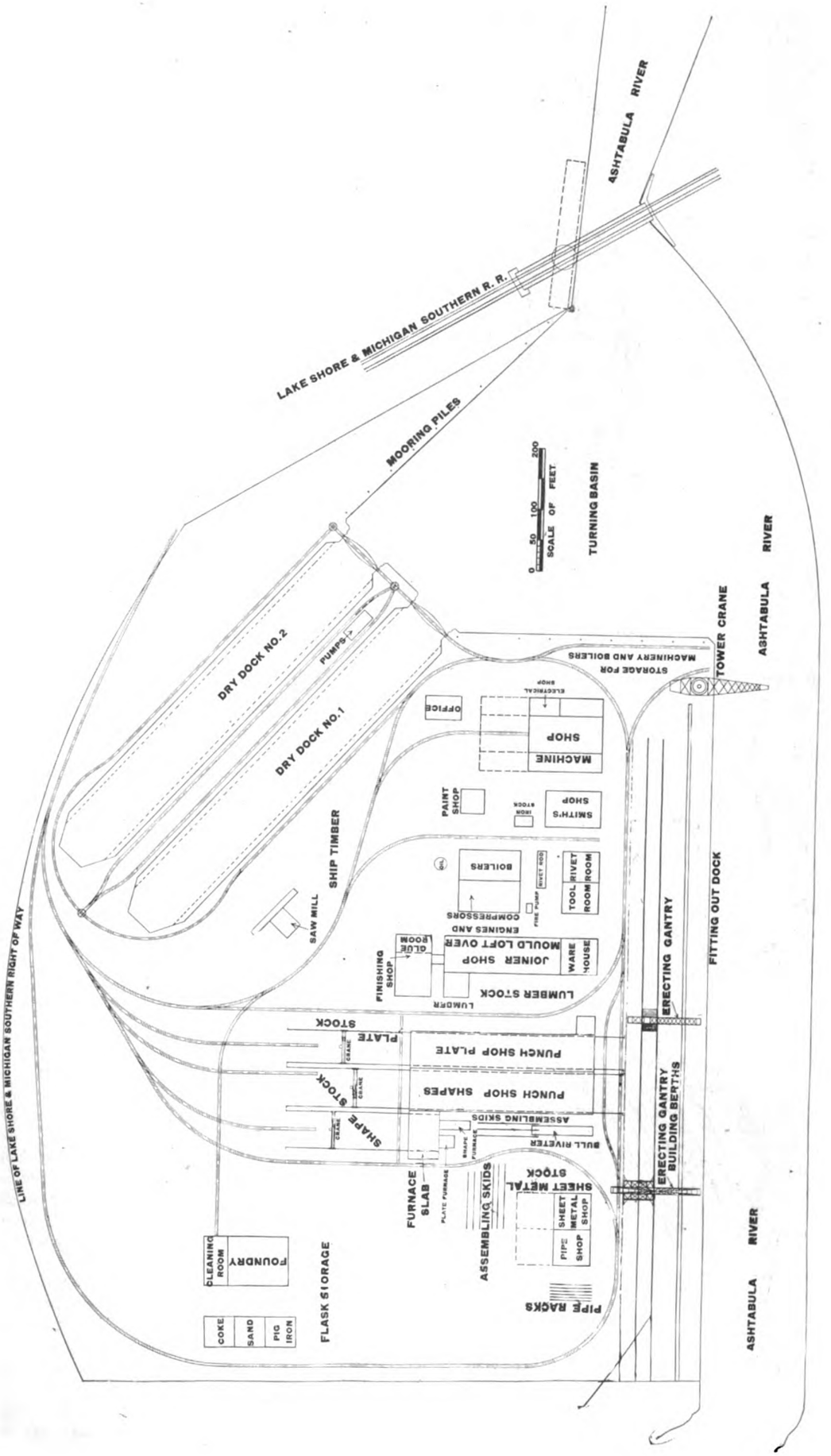

FIG. 2—GENERAL ARRANGEMENT OF THE ASHTABULA SHIP YARD OF THE GREAT LAKES ENGINEERING WORKS.

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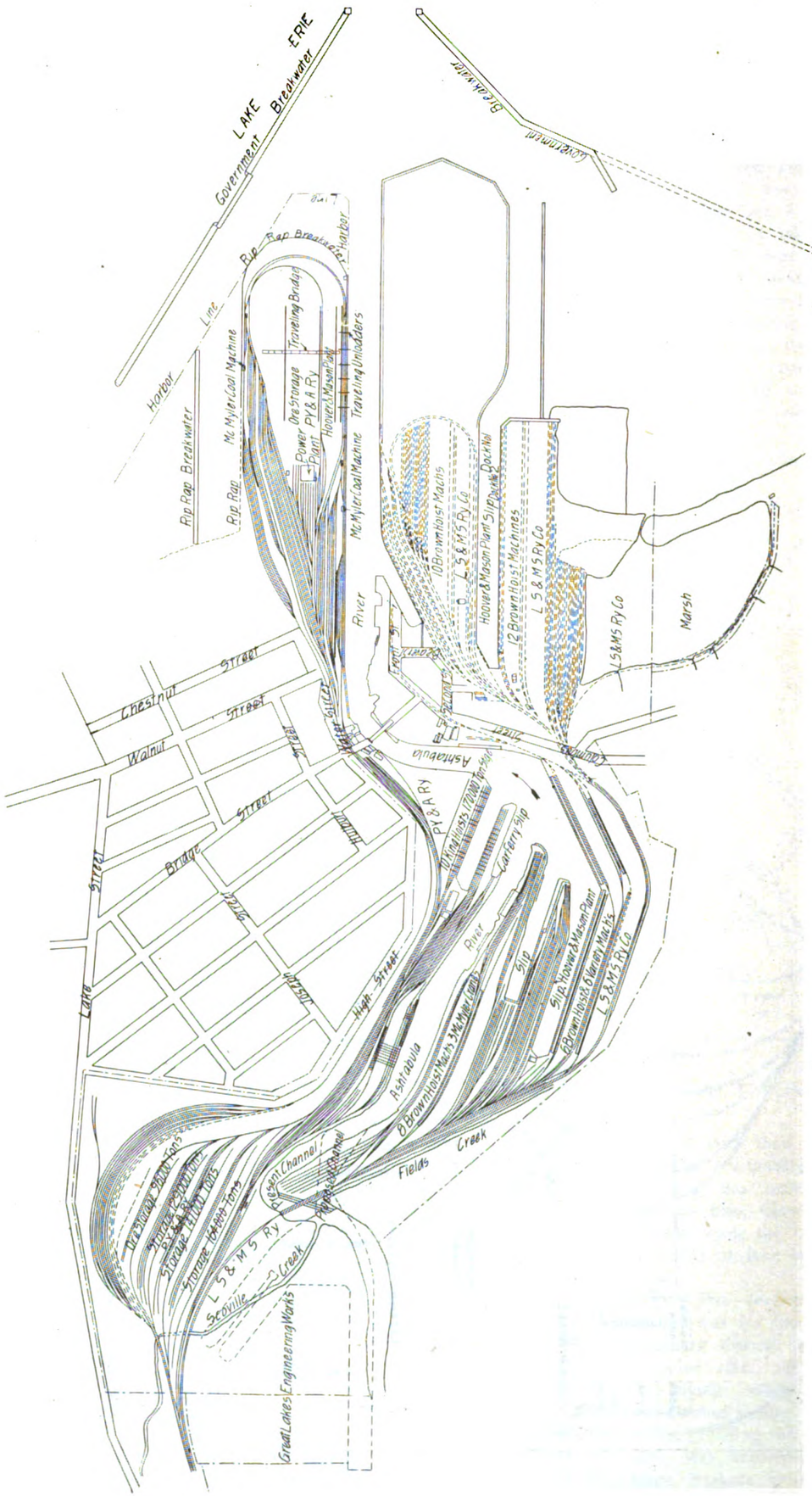

FIG. 3—SHOWING THE DOCK IMPROVEMENTS OF THE LAKE SHORE AND PENNSYLVANIA RAILWAYS.

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alongside the coal cars to the hatch of the vessel. The first ore unloading machines were of substantially the same type, known as whirlies, and the method of handling was simply a reversal of that employed in loading coal, except that the buckets were, of course, comparatively small. As the ore trade increased, Brownhoist machines were installed, and still later Hoover & Mason machines. The rapid increase in the coal trade also compelled the adoption of improved methods, and the Lake Shore railroad installed the first coal loading machine used anywhere on the Great Lakes. This machine was simply a pivoted incline, resembling a children's see-saw, the cars being hauled up by cable and the outer end depressed so that the car on reaching the lower end and the end gate being dropped, discharged the coal into the ship. This machine was installed in what was known as the lake front harbor, and was afterwards replaced by two of a more modern type, which in operation, hoist a loaded car to an elevation from which it is dumped into a pan and thence spouted into the vessel.

Abandoned a $7,000,000 Investment.

Dockage was increased by further dredging in the river and also across the old dock front and in making slips until in 1905 the Lake Shore had a number of docks in coal and ore service and a number of slips which from time to time have been deepened to accommodate the increasing size of vessels. Dockage space had also been created for storing ore until the Lake Shore alone had in round numbers in 1905 a general investment in docks, ore and coal machinery and slips, of about $7,000,000. The crooked channel in the old river was always more or less an inconvenience to shipping, and when about four years ago the present type of 10,000-ton freighter came into existence, the entrance to the various slips through the tortuous channel became almost prohibitive. As the 10,000-ton carrier rapidly multiplied, the Lake Shore prepared to meet the changed conditions by sacrificing its old docks and old machinery and providing new docks and new machinery. It abandoned completely its investment of $7,000,000 and in 1906 began the construction of two very large and entirely new docks on the lake front extending directly out into the lake, each dock containing nearly 30 acres and requiring the renewal of the old breakwater and the construction of a new one further out into the lake. The government provided most of the breakwater, but the railroads had to dredge new slips. These two new docks alone have cost about $2,000,000. They are separated by a slip 200 ft. wide and dredged to a depth of 23 ft.

The New Westerly Dock.

The westerly of these docks has recently been equipped with the most modern ore handling machinery, operated electrically, including one ore bridge 625 ft. long for carrying the ore into dock storage. This machinery faces the intermediate slip and was erected at a cost of $1,500,000. The ore machines are of the Hulett type with buckets of 15 tons capacity, the largest on the lakes. The bridge bucket for carrying ore taken from the trough to dock storage has a capacity of about 18 tons. In equipping this dock the Lake Shore acted in conjunction with the United States Steel Corporation. On this dock also, facing the river channel, a new coal handling machine is being erected at a cost of about $150,000 for next season's business. Tracks and flooring on this dock will probably cost $100,000 more.

New ore machinery, to be ready for service next season, is now being installed on the easterly dock, practically duplicating the machinery on the westerly dock and costing the same amount of money, or about $1,600,000. For the present no coal machines will be erected on the easterly dock. It is expected that next season and thereafter all ore and coal will be handled on these new docks. A little of the machinery will remain on the outer end of the old docks which are coupled up with the new, but the bulk of the old machinery will be scrapped and some of the old slips filled in to make train yards for handling and storage of cars.

Enormous Handling Capacity.

Thus in the past four years, and including up to the opening of next season's navigation, the Lake Shore will have spent for new docks about $2,000,000, for new machinery over $3,000,000, or a total of approximately $5,000,000, and will abandon (except that the ground will be used for tracks) about $7,000,000 worth of property. The old machinery, if ships had continued to be built small enough to use the old slips, could have handled readily between 4,000,000 and 5,000,000 tons of ore per annum and from 1,500,000 to 2,000,000 tons of coal. The new machinery will have ample capacity for at least 2,000,000 tons of coal, and from 7,000,000 to 8,000,000 tons of ore. The Lake Shore handles ore direct from Ashtabula to the Youngstown and Sharon districts and with its connecting line, the Pittsburg & Lake Erie Railway, into the Pittsburg district. The shipping coal comes from the Pittsburg district from mines located or adjacent to the Pittsburg & Lake Erie Railway.

The westerly dock will be occupied, so far as ore is concerned, exclusively by the United States Steel Corporation, while the Pittsburg Coal Co., the largest soft coal company in the United States, will operate the coal machinery on this dock. The easterly dock, as stated, will be equipped with ore handling machinery only for the present. This dock is designed for the service of some six or eight iron companies which are amalgamated into what is known as the Union Dock Co., the largest individual company being the Jones & Laughlin Co. of Pittsburg.

At the present time the Lake Shore is taking out from Ashtabula to the Youngstown and Pittsburg districts from 500 to 800 cars of ore per day, occasionally shipping as high as 1,000 cars and more. During prosperous periods it expects to handle from 6,000,000 to 10,000,000 tons of ore per annum and from 1,500,000 to 3,000,000 tons of coal through this gateway.

Docks of the Pennsylvania Lines.

The docks of the Pennsylvania line all lie west of Ashtabula river. The latest Pennsylvania improvements consist of the construction of docks Nos. 10 and 11, the filling in of the lake between these docks, the erection of six legs of a Hoover & Mason ore unloader on dock No. 10, a McMyler coal machine for loading coal into boats on dock No. 11, a power plant for the operation of these machines and the track development for the proper handling of the business. The McMyler machine on dock No. 10 has been in operation for several years.

Docks Nos. 10 and 11 are constructed of concrete on wooden cribs and the entire development to date represents an expenditure of about $3,500,000. The Hoover & Mason ore unloaders were placed in operation in 1908, but as yet the new machine on dock No. 11 has not been operated, although it is complete. The tracks serving these two docks are now about 50 per cent complete, and will be ready for service in their entirety at the opening of navigation next spring.

A brief description of the method of operation on docks Nos. 10 and 11 may be of interest: Coal loads are placed on the elevator hump tracks from which they feed by gravity and with the aid

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of a wire rope haulage device into the coal machines. The entire car is then elevated and loaded into the boat. The empty car then either passes around the end of the dock under the ore unloading machines or from a kick-back trestle into the empty yards, their direction depending upon the supply of empties on hand to take care of the ore loading. The ore loads are pushed from under the ore machines around the end of the dock from the ore loading yard and then made up into trains for the road. Fig. 3 shows the general arrangement of the docks of the Pennsylvania and Lake Shore railways.

It will thus be seen that the Lake Shore and Pennsylvania systems have expended $8,500,000 for new equipment at the port of Ashtabula during the past four years, nearly trebling its ore handling capacity. The Great Lakes Engineering Works will add approximately $1,000,000 to this in the construction of its plant.

The decision of the Great Lakes Engineering Works to locate at this point is the outcome of many conferences between the Lake Shore and Pennsylvania officials, the chamber of commerce of Ashtabula and President Antonio C. Pessano of the Great Lakes Engineering Works.

Transmission of Intelligence on Steam Vessels.

By H. A. Hornor, Electrical Engineer, New York Ship Building Co.

IV.

Of all essential matters in battleship design that of properly controlling the fire of the guns is without question the most important. A battleship is primarily a fighting machine, and therefore the necessity of so controlling the gun fire as to obtain the greatest possible efficiency. This subject of fire-control has called forth every consideration by the naval authorities, and investigation, experiment and money have not been spared in providing the most reliable systems suggested. Every idea that was worthy of a passing notice has been given due trial and the liberal spirit of the government today would gladly respond to any suggestions whereby greater improvements would result. To clearly understand the arrangements now provided on the latest battleship designs some reference must be made to the arrangement of compartments and the disposition of the guns. The design of recent battleships has been rightly dubbed the "all big gun" type. Our most powerful battleships, those of over 21,000 tons displacement, carry five turrets, containing two 12-in. guns in each turret. Two are located forward, one raised slightly above the other, and three aft, two on the same level and are slightly raised above them. The 5-in. guns used for defense against the attacks of torpedo boats, are distributed at important points on the gun deck. The range, deflection and battle orders for these guns are communicated solely by telephones, as referred to in the description of the telephone system. Not only are the 12-in. turret guns supplied with telephones for this purpose, but also with special instruments for visually presenting the range, deflection and battle orders continuously before the sight-setters and gun trainers.

Watching the Shots.

The orders all emanate from what are called sub-stations, compartments well below the protective deck and water-line, sheltered in every possible way from hostile shell. The range-finding instruments are located in lofty towers, one forward and one aft, with their respective "spotters" and range officers. The spotters, watching each shot as it falls and gaging the range and deflection, communicate directly with the sub-stations by means of the telephone. The range and deflection transmitters in the sub-stations are immediately called into operation and in turn send forth to each gun the proper order. The problem contains another factor. In naval warfare both parties to the conflict are in motion, and by virtue thereof the range is constantly varying. For this condition there is provided in the sub-stations a range clock carrying a rate of change disc, by means of which the rate of change of range may at all times be marked. This range clock has a maximum reading of 14,000 yds. When the shot-spotter reports from the fire-control tower, the rate of change of range is set on the clock. The clock continues then to mark off regular ranges which through the proper official, are then communicated by the range transmitters to the guns. Deflections are noted by the same shot-spotter and in the same way transmitted through the sub-station to the guns. Deflections are measured in yards up to a maximum of 100. Formerly zero was arbitrarily taken at the center, which required the further designation of right or left deflection. By assuming 50 yds. as the zero deflection any number below 50 indicates right and any number above 50 indicates left deflection.

Bunching the Hits.

The cause for all this care in firing guns originates from the desideratum of "bunching" the hits. When several guns are firing particularly in range and their shots are dispersed, poor hitting ensues. Therefore such fire-control systems are important and necessary in that they maintain all the sights of the guns set alike while in the act of firing. Two systems for accomplishing this requirement have been experimented with and have shown about equal advantage and disadvantage from a practical standpoint. It is unnecessary to elaborate a description of either system, suffice it to say that one system is designed on the simple incandescent lamp principle, and the other on a system of magnets in conjunction with the ratchet-motion escapements. In the former indications are produced by illuminating numbers by 5-candle power lamps; in the latter the range and deflection numbers revolve by increments of 50 yds. for range and unit increments for deflection. The latter instruments, though rectangular instead of round, resemble in their movements the familiar fare registers which are seen in all trolley cars. This system provides also for the repetition of the signal after it has been conveyed to the gun at the sending station. Ready means are also provided for cutting out the instruments which may become deranged without affecting the other instruments on the system. This reply or checking feature is convincingly accomplished in the lamp-pattern design by introducing similar indicators at the sending station connected in series with the indicators at the guns. The transmitters in both systems, though the instruments are dissimilar in outward design, are in principle merely switches for closing the desired circuits. The essential difference between the lamp-pattern and the electro-magnet systems is that the former is purely an electric contact method and the latter an electro-mechanical method.

Fire-Control System.

The vital importance which attaches to this fire-control system is shown by the regard with which it is installed. With all these instruments located behind and below armor, in the event that the fire-control towers be completely demolished, communication can be trans-

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mitted from the captain's battle station, which is a small elliptical armored compartment on the superstructure deck. If again by any chance this invulnerable citadel be destroyed, retirement to the sub-station is offered. The latter place can only be made untenable by the sinking of the vessel. When this happens the hull becomes only a hulk and the engine-of-war becomes a derelict.

The last two systems in this classification, namely, local turret gun firing indicator system and turret danger zone system, may consistently be considered together. They have been required mainly because today it is thought one system cannot accomplish all that is desired. And certainly a detailed investigation will convince even the most conscientious designer that a division was absolutely unavoidable. It has been stated that in the "all big gun" design the turrets are disposed, two forward, one above the other, and three aft, two on the same level and one above them. With this alone in mind it becomes apparent that unless due provision is made there will occur in time of war, or target practice, exceedingly dangerous interferences, not only by the various positions of the guns, but also by the turrets which carry them. Casually the suggestion would be to guard the turrets and guns by positive mechanical blocking devices; but this is impractical inasmuch as it restricts to an alarming extent the radius of gun action, a restriction which would reduce the efficiency of the fighting qualities of the vessel to a mere show in battle. The guns have a certain radius of elevation and depression, just as the turret has a fixed radius of train on a horizontal plane. One gun or set of guns in one turret, let it be the raised turret, are set for extreme depression, while the guns in the lower turret are fixed at maximum elevation on the same degree of train. If under these conditions the raised turret guns are fired, they throw their charge with disastrous results at the lower turret guns. A change in train of the raised or lower turret would avoid any such mishap. Here it must be understood that the turret gunners are excluded from external view, hemmed in behind 12 in. of armor. The sighting of the guns is accomplished by prismatic telescopes, which present to the sight setters the image of the object upon which they fire. Augment the many interferences which will arise by the above illustration, by the movement of one turret body into the fighting line of an adjacent turret, and the problem is not only magnified to the extremity of hopeless solution, but becomes utterly exasperating. No instruments for this system have at the present time been manufactured. Designs have been drafted in accord with models of guns and turrets prepared to illustrate the many dangerous interferences.

Difficulties in Every System.

It remains for experimentation and actual trial to demonstrate the need of practical usefulness of a system which perforce must carry with it complications proportional with the results to be obtained. Several methods have been suggested; but to the writer's knowledge only one system has found acceptance at the present time. The principle of the design is based on the desire to eliminate at least as much as possible the use of small shafting and permit the signals to be conveyed by electric currents. Yet the method must introduce the mechanical feature, because the every motion of one gun and one turret must be transmitted to each of the other turrets or guns where interferences may occur. The system comprises two sets of instruments, one set based on purely the lamp-signal system—the transmitter mechanically attached to the gun or turret, and similar, save in size and number of contacts, to the other electrical telegraphs—and the other based on a magnet floating in a circumferential group of magnet coils whose poles alternately present a north pole and then a south pole. This, producing a revolving motion in accord with a mechanically-operated contact maker attached either to a gun or turret, reproduces the movement in another turret. The principle is here briefly stated. The details are not conclusively prepared at present; but the object of accomplishing this work by electrical methods rather than by mechanical are at least set forth. If reliability is found to be more necessary than space, weight and inconvenience, then the mechanical system will prevail. Thus the entire success of the turret danger zone system must await the final verdict of the future.

The Central Station.

Many times during the explanation of the above systems mention has been made of the central station. This compartment is located below the protective deck and covered from danger by armor. Besides furnishing a protected station from which to guide the vessel when the upper pilot-house has been destroyed, it also gives a cover to the necessary switching mechanisms for the supply of current to the interior communication systems. From the captain's battle station, which has been already briefly alluded to, an armored tube 3 ft. in diameter is fitted ending in the central station. This tube protects the steering gear leads as well as the important wires and cables of the essentially battle and navigating circuits. In this room will be found the steering wheel, engine mechanical telegraphs, revolution indicators, helm angle indicator, electric steering telegraph, voice-tube panel, cut-out switchboard, interior communication switchboard (controlling the supply of all circuits for these systems), telephone switchboard, telephone transfer switchboard, general alarm gong contact maker, and warning signal contact maker. Two dynamotors for the energy necessary for the general systems of interior communication are a part of this equipment, but due to their noisy character are debarred from the silent communion with their fellows. This control station is lined on all sides with sound-proofing material, that there may be no interruptions to the service occasioned by the ship machinery. The motor generators for the supply of proper voltages, with alternating and direct current to the telephone system, are located without the central station for the same reasons. The dynamotors for the general communicating circuits are wound to transform the standard voltage of 125 volts into three voltages, 6.6, 13.3 and 19.9 volts. Motor generators in duplicate for the telephone system consist of a motor wound for 125 volts; a direct current generator transforming to a normal voltage of 16 with rheostatic control from 12 to 20 volts, mounted on the same shaft, and an alternating current generator producing 80 volts at 16 cycles, mounted on the same bed plate. These motor generators are controlled by the telephone transfer switchboard and the dynamotors are controlled by the interior communication switchboard.

Interior Switchboard.

This latter switchboard is interesting for the amount of control it provides crowded in so small an area. It is furnished with many sets of bus-bars to accommodate the differences in potential characteristics of the various systems. It supplies 125, 6.6, 13.3, 19.9 volt bus-bars as well as a special set of bus-bars for the batteries which are connected to supply 6.6, 13.3 and 19.9 volts. Adjacent to the central station and made sound proof in like manner are found the sub-stations for fire-control. The two sub-stations permit of duplicate operation of the fire-control, that is to say, that the control

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of all the turret guns can be accomplished from one sub-station or divided between them. Sub-stations are provided to agree with the number of batteries. A change is now contemplated in this arrangement of compartments whereby there will be secured a further structural division, allowing a special compartment to interior communication apparatus. This arrangement will separate and make distinct the steering compartment, communicating or central station and that reserved especially for the control of the gunfire.

Typify the Human Nervous System.

Although briefly described the extensiveness of these systems goes far to prove their importance and necessity. Embracing as they do every possible need of the navigator, the engineer, the gunner, the passenger and the crew they metaphorically typify the human nervous system with all its sensitiveness and delicacy. As the human is debilitated by some injury or shock to his nerves, in like manner does the vessel suffer from an interruption to its interior signals. Following this simile to even a greater degree, man has ingeniously provided the vessel with means of premonition like unto the intuition or fear of approaching danger which man himself possesses. These advantages have transpired through man's experience, study and persevering interest in the making of vessels secure in the carriage of human life and cargo. Not one iota should be spared from the praise of man's achievement as shown in the advantages to the English-speaking races of the two trans-Atlantic fast mail steamers, Lusitania and Mauretania. In diminishing the time of travel between our shores and that of the Fatherland they have advanced the nadir of world civilization.

No attempt has been made to discuss in this paper any practice other than that of our own country. A comparison of the practice of other nations would be interesting, but would extend beyond the prescribed intention of this treatment. It is obvious to those who are well acquainted with American characteristics that in all paths that lead in progress and advancement in science, art and civilization our countrymen will be found in the vanguard.

The Maryland Steel Co., Sparrow's Point, Md., has been awarded contract by the navy department for the construction of a fleet collier at $889,000.

BOOK REVIEWS.

"Robert Fulton and the Clermont." By Alice Crary Sutcliffe, The Century Co., New York, publishers; price $2.10 net.

This work, written by the great granddaughter of Robert Fulton, has great timeliness, as it came from the press in September, just prior to the Hudson-Fulton celebration. While this work adds nothing to what is generally known of Fulton's achievements, it obviously contains much data not ordinarily accessible beyond the family circle. The book contains a number of drawings and portraits not hitherto published. The book incorporates some anecdotes of his early life indicating his mechanical precosity, and also a command of English unusual in a child. For instance, at the age of eight or thereabouts he is said to have rebuked a teacher who disciplined him with a rod on his hand for inattention to his studies by saying "Sir, I came to have something beaten into my brains and not into my knuckles," and at another time he said to his teacher, "Sir, my head is so full of original notions that there is no vacant chamber to store away the contents of dusty books." It is not credible that at so early an age Fulton talked so much like Dr. Johnson.

The early bent of Fulton's mind was towards art and he later achieved a considerable reputation as a painter of miniatures. His mind, however, was fundamentally mechanical. He was about 10 years old when the American revolution occurred and it was doubtless due to this stimulation that his first invention should have been an air gun. There is no record, however, of its success. At the age of fifteen he manufactured a small working model of a fishing boat to be propelled by paddles, and actually made a set of paddle wheels for Christopher Gumpf's boat to be operated by a double crank motion. This invention was tried on the Conestoga river and was found satisfactory.

At the age of 17 he left home to seek his fortune in Philadelphia as a painter of portraits in miniature. He remained in Philadelphia for four years and in 1786 left for London to pursue his art studies. For several years thereafter he supported himself in painting portraits, incidentally meeting men of great distinction, including the Duke of Bridgewater and Earl Stanhope. Bridgewater was engaged in constructing a canal to open up the coal lands on his estates and Stanhope was working on a plan for the application of steam to navigation. It is quite likely that association with these men was responsible for Fulton's abandonment of the career of an artist for that of an engineer. At any rate he became very active thereafter in mechanics. He pointed out the impractical nature of Stanhope's plans and in a letter written during 1793 from Devonshire gave the earl the very principles of his own application which afterwards were successfully demonstrated on the Hudson river. This letter, incorporated in the book, is quite interesting.

Fulton also turned his attention to canals and in 1794 secured from the British government a patent for a double inclined canal plane for raising and lowering canal boats. About the same period he also obtained English patents upon a machine for spinning flax and for a new invention for twisting hemp rope. His mind, however, apparently turned towards the development of canal systems, for he obtained a patent upon a dredging machine and later patented two types of boats for use upon canal systems. In 1796 he published a treatise on canal navigation. This pamphlet was later translated into French and published in Paris. In 1797 he addressed a communication to the French Directory on the subject. About this time the excesses of the French revolution had ceased and England had begun her system of aggression upon the seas through which the United States was the greatest sufferer. This caused Fulton to abandon his study of canals and to turn his attention to the creation of an implement of destruction, which resulted in the invention of a submarine boat equipped with torpedoes. Fulton's experiments with the submarine boat Nautilus and his failure to enlist the interest of Napoleon in it are too well known to require comment, as are also his subsequent negotiations with the British government to the same end. In 1806 Robert Fulton returned to his native land from which he had been absent for twenty years.

No attempt is made to claim the invention of the steamboat as original with Fulton. Fulton himself, probably more than any other one man, was aware of what had been done along the line of experiments in steamboats. Fulton's early experiments were conducted on the Seine in partnership with Robert Livingstone, then United States minister to France. Fulton built a boat 70 ft. long, 8 ft. wide and 3 ft. deep, upon which he placed a steam engine of about 8 H. P. In July, 1803, an experiment was made by Fulton with this boat in the presence of a great number of people, including Car-

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not, and a speed of about 3¼ miles was achieved.

Concerning Fulton's plans for the introduction of steam navigation on the Hudson, the book is quite rich in private memoranda—calculations made by Fulton concerning types of boats and probable earnings on the trip from New York to Albany. Letters are also submitted showing the difficulties which Fulton encountered in getting a steam engine for his boat from Boulton & Watt of England. The first engine was ordered in 1803, but the order was declined because the firm was unable to get permission to forward the engine to the United States. Fulton then endeavored to obtain an engine through James Monroe, the American minister to Great Britain, but apparently met with no success—at any rate he did not get the engine. In January, 1805, he made a payment of £584 upon the engine and in March received permission to ship it to America. It is not known what date the engine arrived in America, but it was in Mr. Barker's warehouse on South street, New York, for several months prior to its erection in the boat. This was constructed by Charles Brownne at Corlear's Hook on the East river and was named Clermont in honor of Livingstone's country place on the Hudson.

The commercial success which the Clermont attained led within a few months to the necessity of its enlargement and development and this reconstruction obscured the knowledge of the initial plans for the first American boat which until recently had been considered lost. An important discovery of four folios of Fulton's original drawings at the New Jersey Historical Society presented about 30 years ago by the late Solomon Alosson, a Hollander, who had a fondness of collecting historical data, has brought to light two of Fulton's original drawings of 1806. These plans are reproduced in the book for the first time. Mr. Frank E. Kirby in commenting on them says: "The discovery of these plans of Robert Fulton's is the most important addition to the authentic history of early steam navigation."

The book then relates the early trips of the Clermont, including letters from Fulton himself and much matter concerning the regulation of passengers, which makes quite amusing reading today. Fulton was 42 when he built the Clermont. His engagement to the daughter of Chancellor Livingstone was announced on one of these trips. During the remainder of his life, which was only eight years, he built no less than 17 steamboats.

"Manual for Engineers", published by the University of Tennessee Press, Knoxville, Tenn., pocket size, price 50 cents.

This little manual has been revised and its information brought up to date. Some of the important tables in the book are as follows: Areas and circumferences of circles; square and cube root; sines, tangents and secants, both natural and common; steam tables dealing with capacity of turbines; tables for electric wiring and interest tables.

Lloyds Register of American Yachts. 440 pages. 7 x 9 in. Cloth or canvas binding. Published by Lloyds Register of Shipping, 17 Battery Place, N. Y.

A new evidence of the widening influence of the motor boat on older and more conservative forms of yachting is seen this year in the Yacht Register. The handsome and elaborate binding of blue cloth and gold which, as best suited to the saloon of the large yacht or the library of the club house as heretofore been distinctive of the book, is now supplemented by a very plain but ship-shape binding in yacht canvas, at a lower price, to meet the more modest means of the owners of the small power cruiser, as well as the rougher use on the small craft. Useful as it is on a yacht, to the cruiser in the small craft the Yacht Register is simply indispensable; the owner of a large yacht with professional skipper and crew, is independent alike of the shore and of other vessels, the little fellow, on the other hand, is directly interested for aid and company on the clubs which he may visit and the owners of the many yachts of his own class which he may meet. What he most wants to know is where the clubs are located, who the officers may be, who own the yachts which he meets by day and anchors among by night, and from what ports and clubs they may hail? These questions, and many more like them, are answered fully and correctly in the Yacht Register.

The new volume contains the particulars of 3,355 yachts, distributed over the waters of the United States, Canada and the West Indies, with a list of the names, addresses and clubs of the 3,200 owners of these yachts. No fixed limit of size is followed, but such small yachts as are of more than local interest, the open launches which defend the British international trophy and the A. P. B. A. gold cup, and the small sloops of the Sonder-class, with other notable small yachts, are included.

The full particulars of 412 yacht clubs and 25 yachting associations are given, with the burgess in colors of 404 of those organizations. A special feature of the book is the collection of private signals of yacht owners, 30 plates with 1,921 flags, making it possible to identify a yacht whenever the flag is visible.

The club list shows an increase throughout the interior, where launch clubs are being formed in large numbers on the rivers and small streams previously considered unfitted for any form of yachting, and also in the extreme Northwest, in the vicinity of Vancouver, B. C., and Seattle, where yachting is growing rapidly in popularity.

The yacht list is marked by the absence of many famous old yachts, notably those of the Burgess era, Puritan, Mayflower and many smaller craft which have disappeared from the Register either through conversion to trading use or through a total breaking-up for their lead. On the other hand, there is a marked increase in the number of cruising launches of all sizes from 30 up to 100 ft., most of them of the new "raised-deck" type which gives such excellent room below, and all fitted with gasoline engines. The book as a whole gives evidence that in spite of the poor business conditions of the past few years and the great change that has taken place in the decreasing number of sailing craft, yachting is still one of the most popular and flourishing of American sports.

SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS.

The seventeenth meeting of the society of naval architects and marine engineers will be held in Assembly room No. 1, Engineering Societies building, 29 West Thirty-ninth street, New York, on Thursday and Friday, Nov. 18 and 19. The sessions will begin at 10 o'clock each day. On Friday evening the customary banquet will be held at Delmonico's. The program of papers is as follows:

Thursday, Nov. 18, 1909.

1. "Evolution of Screw Propulsion in the United States." By Charles H. Cramp.

2. "The Influence of Parallel Middle Body Upon Resistance." By Naval Constructor D. W. Taylor, U. S. N., vice president.

3. "The Influence of the Position of the Midship Section on the Resistance of Some Types of Vessels." By

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Prof. H. C. Sadler, member of council.

4. "Some Ship-shaped Stream Forms." By Assistant Naval Constructor Wm. McEntee, U. S. N., member.

5. "Applications of Electricity to the Propulsion of Naval Vessels." By W. L. R. Emmet.

6. "The Producer Gas Boat Marenging." By H. L. Aldrich, member of council.

7. "Building and Equipping Non-Magnetic Auxiliary Yacht Carnegie, With Producer Gas Propelling Equipment." By Wallace Downey, Associate member.

Friday, Nov. 19, 1909.

8. "The Design of Submarines." By Harley F. Hay, member.

9. "The Foreign Trade Merchant Marine of the United States. Can it be Revived?" By Gerge W. Dickie, member of council.

10. "Material Handling Arrangements for Vessels on the Great Lakes." By Alexander E. Brown, member.

11. "Structural Rules for Ships." By James Donald, member.

12. "Rivets in Tension." By Robert Curr, member.

13. "The Strength of Watertight Bulkheads." By Prof. William Hovgaard, member.

14. "Cruising Motor Boats." By E. T. Keyser.

COAST COAL LOADING AND UNLOADING RECORDS.

The performances of the colliers Everett, Malden and Melrose, built at the yard of the Fore River Shipbuilding Co. for the New England Coal & Coke Co., have been such as to justify their construction and to prove the economy and dispatch over the old method of moving coal in schooners and tow barges. The records of dispatch in loading and unloading are creditable and are quite equal to dispatch on the lakes in the handling of coal. The New England Coal & Coke Co. has supplied THE MARINE REVIEW with its loading and unloading records, saying:

"Our fastest loading times to date are:

"S. S. Malden loaded at B. & O. pier, Curtis Bay, Baltimore, April 12, 1909, 6,883 tons gas coal and 298 tons bunkers in 5 hours, 15 minutes. S. S. Melrose loaded at B. & O. pier, Curtis Bay, Baltimore, Sept. 20, 1909, 6,990 tons gas coal and 253 tons bunker coal in 5 hours.

"At Western Maryland R. R. Pier, Port Covington, Baltimore, our steamers usually load about 7,260 tons steam coal cargo and 260 tons bunkers in 8 or 9 hours.

"At C. & O. R. R. Pier, Newport News, our steamers have usually loaded 7,250 to 7,300 tons steam coal and 250 tons bunkers in 18 to 24 hours.

"At Norfolk & Western R. R., Lamberts Point Pier, Norfolk, Va., our steamers have usually loaded about 7,200 tons Pocahontas coal and 250 tons bunkers in 24 to 26 hours.

"At Virginian R. R. Coal Pier, Sewalls Point, Va., S. S. Melrose loaded on Aug. 26, 1909, 7,352 tons steam coal cargo and 229 tons bunkers in 9¼ hours. Only two voyages have been made so far to this pier, but they expect very shortly to load our steamers in 6 hours.

"Our best discharging time has been at New England Gas & Coke Co.'s Everett Works, Boston, 7,210 tons in 12 hours 50 minutes working time and at Mystic Wharf, B. & M. R. R., in about 15 hours.

"The equipment at Everett Works at present consists of six coal hoisting towers with machinery by Mead-Morrison Mfg. Co., and having two-ton grab buckets. These are being added to and we expect shortly to discharge these steamers in 8 hours.

"Similar arrangements are in use at Mystic Wharf, but discharging is delayed by waiting for cars, not working nights, etc.

"The special type of construction of these steamers enables cargo to be loaded or discharged with an extremely small expense for trimming and being constructed as first-class ocean-going cargo steamers, enables them to make their passages from port to port at all seasons of the year with great regularity."

RECORD IN SHIP CONSTRUCTION.

The steamship Salvador has recently been completed by Messrs. Swan, Hunter & Wigham Richardson Ltd., at their Neptune Shipyard, Walker-on-Tyne. The construction work has been carried out by them in 64 working days from the placing of the order—a performance which is claimed to constitute a record for a vessel of this size and class. This steamer, which is built with a clipper bow, is 255 ft. in length over all, by 33 ft. 6 in. beam, and has been constructed to the highest class in Lloyds Register. There is accommodation for 20 first class passengers in deck houses amidships. The propelling machinery, built at the Neptune works, consists of a set of triple expansion engines, supplied with steam by two natural draft boilers. The vessel has been built to inaugurate the new service to be started in December next by the Salvador Railway Company between their railway terminus Acajutla and Salina Cruz, which is destined to reduce considerably the time now occupied between London and New York and Salvador and the west coast of Central America generally.

Of course, comparisons are odious, and in fact there are some things which cannot be compared, but it might be mentioned that the building at the Lorain yard of the American Ship Building Co. of the bulk freighter J. Q. Riddle, 552 ft. over all, 532 ft. keel, 56 ft. beam and 31 ft. deep, in forty-five working days was as creditable a performance as this. Certainly the Riddle has three times more material worked into her than the Salvador.

NEW MARINE REPAIR FIRM AT TACOMA.

The McConnell Engineering & Machinery Co., Tacoma, Wash., has been reorganized under the name of the Phoenix Engineering Co. Thomas Skinner, formerly of Hongkong, China, is president of the new corporation. Niven McConnell, formerly president of the McConnell Engineering & Machinery Co., has disposed of his holdings in the Tacoma corporation and been appointed superintendent of the works of the Standard Steel Car Co., Butler, Pa.

Mr. Skinner and the new owners of the company will change its policy considerably and will devote special attention to marine work. Mr. Skinner is a marine engineer of wide experience, as are the other officers af the new corporation and the company is well fitted to do marine work.

The company's first marine work consists of an extensive overhauling of the steel French bark Zinita, which recently arrived on Puget Sound loaded with pig iron from Europe. The work on the Zinita includes fitting new ends on the main yard and the fore topsail yard, tightening the standing rigging, repairing several deck beams and hanging knees, painting and general overhauling.

The tug William D, which was sunk near the channel in the outer harbor at Ashtabula on Oct. 23, was successfully raised and removed from the channel Oct. 31. The channel is now clear.

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Iron Ore Trade of the Lakes

HEREWITH is presented a statistical summary of the iron ore trade of the great lakes, the dominant trade of the lakes, and judged as a single item, the largest trade in the world. The statistical summary gives the shipments by ranges since iron ore was discovered in the Lake Superior country the rail rate from the mines to the shipping docks, the vessel freight rate, the price of ore delivered at lower lake ports and the average price of pig iron annually. The tables have value, if not commercially, at least historically.

LAKE FREIGHT RATES ON IRON ORE.
(From ports named to Lake Erie.)

Year.	Escanaba.	Marquette.	Ashland and other ports at head of Lake Superior.
1855		$3.00	
1856		3.00	
1857		2.67	
1858		2.09	
1859		2.00	
1860		2.00	
1861		2.21	
1862		2.89	
1863		3.19	
1864		3.37	
1865		3.23	
1866	$3.77	4.17	
1867	3.28	2.98	
1868	2.44	3.11	
1869	2.43	3.21	
1870	2.40	3.06	
1871	2.07	2.83	
1872	2.50	3.59	
1873	2.74	3.44	
1874	No shipment	3.84	
1875	No shipment	2.87	
1876	No shipment	2.54	
1877	No shipment	1.40	
1878	.85	1.26	
1879	1.07	1.61	
1880	1.77	2.50	
1881	1.55	2.25	
1882	1.22	1.50	
1883	1.11	1.30	
1884	.98	1.21	
1885	.84	1.01	$1.20
1886	1.16	1.35	1.49
1887	1.49	1.75	2.11
1888	.97	1.22	1.34
1889	1.00	1.14	1.29
1890	.99	1.16	1.26
1891	.74	.96	1.05
1892	.87	1.06	1.20
1893	.70	.85	.88
1894	.53	.70	.79
1895	.64	.83	.96
1896	.61	.80	.91
1897	.45	.60	.63
1898	.48	.60	.61
1899	.72	.84	.95
1900	.85	.94	1.05
1901	.62	.74	.84
1902	.59	.68	.76
1903	.63	.73	.83
1904	.54	.61	.70
1905	.60	.70	.76
1906	.60	.70	.75
1907	.60	.70	.75
1908	.50	.60	.65
1909	.50	.60	.65

PRICES OF IRON ORE AT LOWER LAKE PORTS FOR EACH RANGE SINCE OPENING.

	Marquette		Menominee		Vermillion		Mesabi	
Year.	Bessemer	Non-Bessemer	Bessemer	Non-Bessemer	Bessemer	Non-Bessemer	Bessemer	Non-Bessemer
1855	$10.00	$10.00						
1856	8.00	8.00						
1857	8.00	8.00						
1858	6.50	6.50						
1859	6.00	6.00						
1860	5.25	5.50						
1861	5.25	5.00						
1862	5.25	5.37						
1863	7.50	7.50						
1864	8.50	8.50						
1865	7.50	7.50						
1866	9.50	9.50 to 14.00						
1867	10.50	8.00 to 11.50						
1868	8.25	8.25						
1869	8.25	9.50						
1870	8.50	8.50 to 9.50						
1871	8.00	8.00						
1872	9.00	7.50						
1873	12.00	9.00						
1874	9.00	7.00						
1875	7.00	5.50						
1876	6.75	4.50						
1877	6.50	4.25						
1878	5.50	4.25						
1879	6.25	4.75						
1880	9.25	8.00						
1881	9.00	7.00						
1882	9.00	6.25						
1883	6.25	5.00	$6.00	$4.75				
1884	5.76	4.50	5.25	4.50	$4.75	$4.50		
1885	5.50	4.25	4.75	4.00	5.00	4.00		
1886	5.50	4.75	5.25	4.50	5.75	4.50		
1887	7.25	5.25	6.00	5.00	6.75	5.00		
1888	5.50	4.75	4.75	4.00	5.75	4.00		
1889	5.50	4.50	4.50	4.50	5.50	4.50		
1890	6.75	5.75	5.50	5.25	6.50	5.50		
1891	6.00	4.75	4.50	4.25	5.50	4.00		
1892	5.50	4.85	4.50	3.65	5.65	4.85		
1893	4.25	3.00 to 3.50	3.85	3.20	4.50	4.00	$3.00	
1894	2.75	2.15	2.75	2.50	3.35	3.00	2.35	
1895	2.75 to 3.50	2.15 to 2.30	2.90	2.25	3.40	3.00	2.15	$1.90
1896	4.00	2.45 to 2.85	4.00	2.70	3.50	2.25	3.50	2.25
1897	2.65	2.00 to 2.60	2.60	2.15	2.25	1.90	2.25	1.90
1898	3.10 to 3.35	2.35 to 2.45	2.75	1.85	2.25	1.75	2.25	1.75
1899	3.21 to 3.50	2.50	3.00	2.15	2.40	2.00	2.40	2.00
1900	5.93 to 6.48	5.00	5.50	4.25	4.50	4.00	4.50	4.00
1901	4.60 to 4.92	3.65 to 3.85	4.25	3.00	3.25	2.75	3.25	2.75
1902	4.65 to 5.00	3.80 to 4.00	4.25	3.25	3.25	2.75	3.25	2.75
1903	4.85 to 5.15	4.00 to 4.25	4.50	3.60	4.00	3.20	4.00	3.20
1904	3.60 to 3.85	3.10 to 3.35	3.25	2.75	3.00	2.50	3.00	2.50
1905	3.75	3.20	3.75	3.20	3.50	3.00	3.50	3.00
1906	4.25	3.70	4.25	3.70	4.00	3.50	4.00	3.50
1907	5.00	4.20	5.00	4.20	4.75	4.00	4.75	4.00
1908	4.50	3.70	5.00	4.20	4.75	4.00	4.75	4.00
1909	4.50	3.70	4.50	3.70	4.50	3.70	4.25	3.50

Iron ore was discovered in the Lake Superior country in 1844, but it was not until 1855 when the ship canal at Sault Ste. Marie was finished that shipments were commercially practicable. Prior to that time about 3,000 tons of ore had been consumed in Catalan forges in the peninsula and in the small blast furnaces of Pennsylvania and Ohio. This ore had been hauled in sleighs to the shore of the lake and portaged around the falls at Sau't Ste. Marie, a most tedious and expensive process.

It will be noted in the table giving the rail freights of iron ore from the mines to shipping docks that the rate for 1855 was placed at $3 as against $1.27 for 1856. The railway which had been projected for Marquette to the Jackson and Cleveland mines on the Marquette range was not quite finished when the canal was opened, so that all the ore shipped that year had been hauled from the mines to Marquette in sleighs at a cost of $3 per ton. The ore brought down that year, some 1,449 tons, all shipped by the old Cleveland Iron Mining Co., now the Cleveland-Cliffs Iron Co., was sold at $10 a ton. It will be observed that this price has been exceeded three times in the history of the trade, in 1866, 1867 and 1873.

In compiling the lake freight rate the average price has been taken. During 1855 and 1856 the ore was moved at a flat rate of $3 per ton, but in later years, notably 1866, a number of cargoes were moved at $6 per ton, the highest rate ever paid on the lakes. The rail rate from the Marquette range underwent a steady reduction until 1894, when it was established at 32 cents. It has been held at this figure continuously since with the exception of the years from 1899 to 1904, when it was reduced to 25 cents.

When the Mesabi range was opened the rail rate was established at 80 cents and has been maintained at that figure ever since. In fact, when the Rockefeller interests controlled both the railway and the mines, there was a provision in the contract that if the rail rate was ever adjudged by the state to be excessive, such reduction as it might suffer should be added to

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the royalty on the ore. The Vermillion rate has also been maintained at an even figure, ranging from $1 to 80 cents, according to the length of haul.

In the schedule of pig iron prices it will be noted that the highest prices were in the concluding years of the civil war. As high as $75 was paid for pig iron in 1864, the average for the year being $59.25. The lowest average was in 1897, following a period of four years' depression, when it fell to $8.35 a ton.

Since the ranges were discovered 407,060,116 gross tons have been shipped from the mines, of which enormous total Mesabi, which was only developed in 1892, has contributed 167,527,143 tons; Marquette, the oldest of the ranges, 87,647,819 tons; Menominee, 66,337,670 tons; Gogebic 56,732,446 tons; Vermillion 28,017,170 tons; with unclassified shipments of 797,868 tons.

The Canadian Graving Dock & Ship Building Co., Ltd., has been formed at Montreal for the purpose of building graving docks and to establish a large modern ship building plant either in Montreal or Quebec.

PRICES OF PIG IRON SINCE 1854.

1855	$27.75
1856	27.12½
1857	26.37½
1858	22.25
1859	23.37½
1860	22.75
1861	20.25
1862	23.87½
1863	35.25
1864	59.25
1865	46.12½
1866	46.87½
1867	44.12½
1868	39.25
1869	40.62½
1870	33.25
1871	35.12½
1872	48.87½
1873	42.75
1874	30.25
1875	25.50
1876	22.25
1877	18.87½
1878	17.62½
1879	21.50
1880	28.50
1881	25.12½
*1882	21.85
1883	19.04
1884	17.16
1885	15.27
1886	18.96
1887	21.37
1888	17.38
1889	18.00
1890	22.15
1891	15.15
1892	16.40
1893	12.65
1894	9.65
1895	9.40
1896	12.40
1897	8.35
1898	9.55
1899	10.30
1900	24.15
1901	16.15
1902	15.90
1903	21.50
1904	13.35
1905	15.50
1906	17.25
1907	21.50
1908	18.00
1909	18.50

*Prior to 1882 prices are for No. 1 anthracite foundry pig iron at Philadelphia. Succeeding figures are for Bessemer pig iron at Pittsburg.

YEARLY SHIPMENTS OF IRON ORE FROM VARIOUS RANGES OF LAKE SUPERIOR DISTRICT.

Year.	Marquette	Menominee	Gogebic	Vermillion	Mesabi
1855	1,449				
1856	36,343				
1857	25,646				
1858	15,876				
1859	68,832				
1860	114,401				
1861	49,909				
1862	124,169				
1863	203,055				
1864	243,127				
1865	236,208				
1866	278,796				
1867	475,367				
1868	491,449				
1869	617,444				
1870	830,940				
1871	779,607				
1872	900,901				
1873	1,162,458				
1874	919,557				
1875	891,257				
1876	992,764				
1877	1,010,494	4,593			
1878	1,033,082	78,028			
1879	1,130,019	245,672			
1880	1,384,010	524 735			
1881	1,579,834	727,171			
1882	1,829,394	1,136,018			
1883	1,305,425	1,047,415			
1884	1,548,034	895,634	1,022	62,124	
1885	1,480,422	690,435	119,860	225,484	
1886	1,627 383	880,006	747,589	304,396	
1887	1,851,414	1,193,343	1,303 267	394,252	
1888	1,918,750	1,191,101	1,424 699	511,953	
1889	2,634,816	1,796,755	2,016,391	844,682	
1890	2,993,664	2,282,237	2,847,786	880,014	
1891	2 512,242	1,824,619	1,839,574	894,618	
1892	2,665,169	2,261,499	2,971,991	1,167,650	4,245
1893	1,837,580	1,466,197	1,329,385	820,621	613,620
1894	2,059,330	1 137,949	1,809,468	948,513	1,793,052
1895	2,097,838	1,923,798	2,547,976	1,077,838	2,781,587
1896	2,604,221	1,560,467	1,799,971	1,088 090	2,882,079
1897	2,715 035	1,937,013	2,258,236	1,278,481	4,275,869
1898	3,125,039	2,522,265	2,498,461	1,265,143	4,613,766
1899	3,757,010	3,301,052	2,795,856	1,771,502	6 626,384
1900	3,457,522	3,261,221	2,875,295	1,655,820	7,803,535
1901	3,245,346	3,619,053	2,938,155	1,786,063	9,004,890
1902	3,868,025	4,612,509	3,654,929	2,084,263	13,342,840
1903	3,040 245	3,749,567	2,912,708	1,676,699	12,832,542
1904	2,843,703	3,074,848	2,398,287	21,822,839	12,156,008
1905	4,210,522	4,495,431	3,706,737	34,353,456	20 153,699
1906	4,057,187	5,109,088	3,641,985	1,792,355	23,792,553
1907	4,388 073	4,964,728	3,637,907	1,685,267	27,492,949
1908	2,414,632	2,679,156	2,699,856	841,544	17,257,350

RAIL FREIGHTS ON IRON ORE FROM MINES TO LAKE SHIPPING POINTS

	Marquette Range.		Menominee Range.	Gogebic Range. Ashland.		Mesabi and Vermilion Ranges.				
Year.	Marquette.	Escanaba.	Escanaba.	Wis. Cent. Railway.	C. & N. W. Railway.	Duluth.	Superior.	Ely.	To Two Harbors from Tower & Other Soudan. points.	
1855	$3.00									
1856	1.27									
1857	1.27									
1858	.87									
1859	.87									
1860	1.09									
1861	1.09									
1862	1.09									
1863	1.09									
1864	1.09									
1865	1.10									
1866	1.10	$1 55								
1867	1.10	1.80								
1868	1.10	1.80								
1869	1.10	1.85								
1870	1.10	1.85								
1871	.95	1.70								
1872	.84	1.70								
1873	.84	2.00								
1874	.84	2.00								
1875	.65	1.25								
1876	.55	1.15								
1877	.55	1.15								
1878	.55	1.15								
1879	.55	1.15								
1880	.55	1.25								
1881	.55	1.25								
1882	.55	1.25								
1883	.55	1.10								
1884	.40	.80								
1885	.45	80								
1886	.55	.80								
1887	.55	.80	$0.85	$0.80	$0.80					
1888	.45	.70	.75	.70	.70					
1889	.45	.70	.75	.70	.70					
1890	.45	.70	—	.70	--					
1891	.45	.70	.70	.65	.65					
1892	.40	.65	.70	.65	.65	$0.80	$0.80	$1.00	$0.90	$0.80
1893	.40	.65	.70	.65	.65	.80	.80	1.00	.90	.80
1894	.32	.52	.70	.52	.65	.80	.80	1.00	.90	.80
1895	.32	.52	.52	.52	.52	.80	.80	1.00	.90	.80
1896	.32	.52	.52	.52	.52	.80	.80	1.00	.90	.80
1897	.32	.52	.52	.45	.52	.80	.80	1.00	.90	.80
1898	.32	.40	.45	.40	.45	.80	.80	1.00	.90	.80
1899	.25	.40	.40	.40	.40	.80	.80	1.00	.90	.80
1900	.25	.40	.40	.40	.40	.80	.80	1.00	.90	.80
1901	.25	.40	.40	.40	.40	.80	.80	1.00	.90	.80
1902	.25	.40	.40	.40	.40	.80	.80	1.00	.90	.80
1903	.25	.40	.40	.40	.40	.80	.80	1.00	.90	.80
1904	.25	.40	.40	.40	.40	.80	.80	1.00	.90	.80
1905	.32	.40	.40	.40	.40	.80	.80	1.00	.90	.80
1906	.32	.40	.40	.40	.40	.80	.80	1.00	.90	.80
1907	.32	.40	.40	.40	.40	.80	.80	1.00	.90	.80
1908	.32	.40	.40	.40	.40	.80	.80	1.00	.90	.80
1909	.32	.40	.40	.40	.40	.80	.80	1.00	.90	.80

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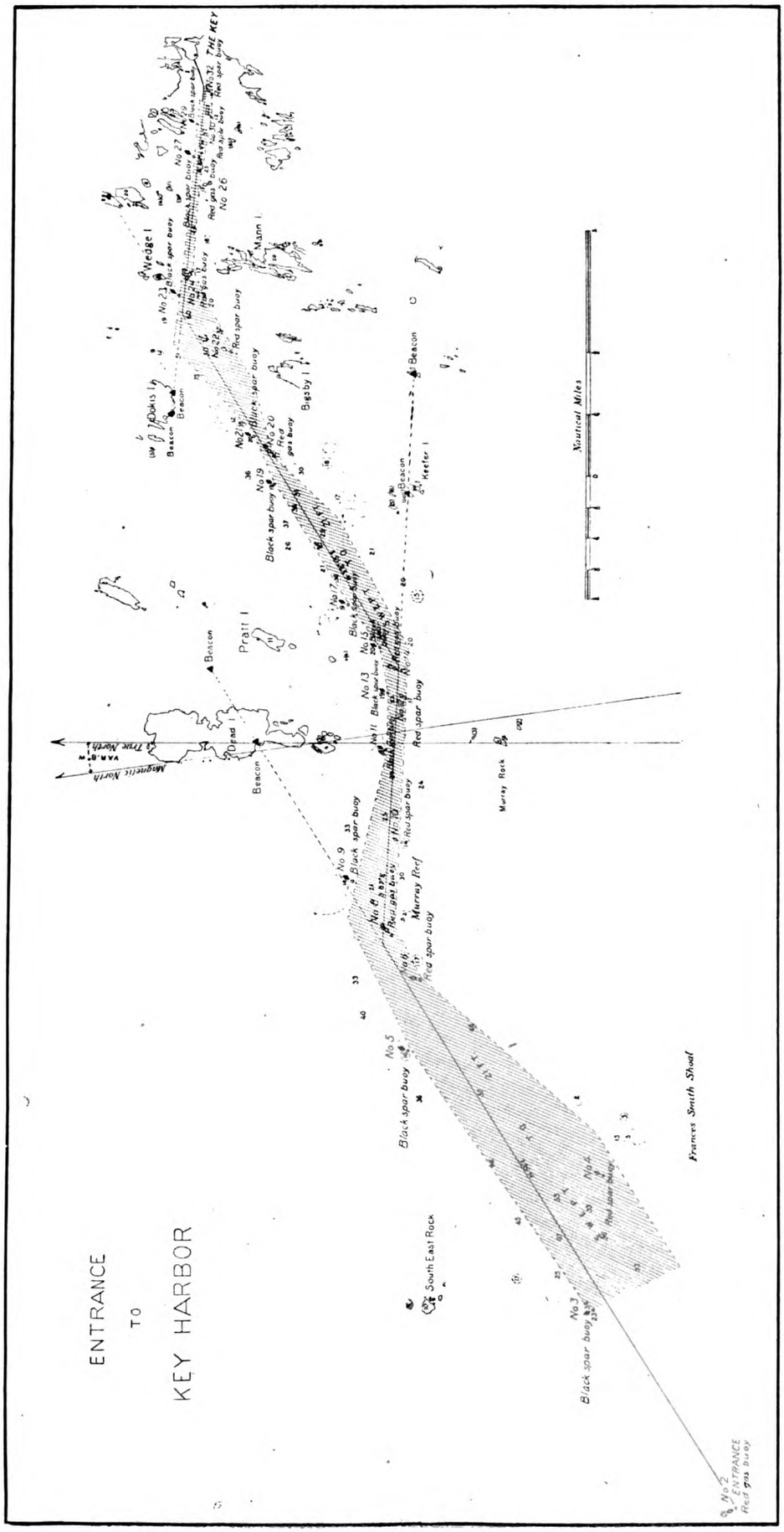

KEY HARBOR SAILING DIRECTIONS.

N.M.39.08

Key inlet, at the northeastern extremity of Georgian bay, Lake Huron, has been selected by the Canadian Northern railway as a Great Lakes terminal. Ore loading and coal unloading plants have been constructed at the port and the first cargo of ore was shipped from the port about six weeks ago. Vessel masters are now seeking sailing directions to the port.

The sketch herewith published is taken from a blue print issued by the Hydrographic Survey Office, Department of Marine and Fisheries, Ottawa, and shows the entrance channel leading into Key inlet as swept to a depth of 21 ft., together with buoys and range beacons established to mark the outlying dangers and lead in the deepest water.

The channel from the outer or entrance buoy to the pier at the port consists of four principal courses or sections. The outer section of the channel is marked by a pair of range beacons 2,110 ft. apart erected on Dead island; the second section by a pair of beacons 2,960 ft. apart on the Keefer islands; the third section by a pair of beacons 2,370 ft. apart erected on Wedge island and an island east-north-eastward from it, and the fourth section by a pair of beacons 630 ft. apart erected on Dokis island. These beacons are all of wood. The front one of each range is pyramidal in shape, about 12 ft. high, and painted white; the rear one shows rectangular in the line of range above the front one, and is painted white with a black stripe down the middle of its face.

Six gas buoys, all painted red and showing intermittent white lights, have been moored at the turning points in the channel and should be left on the starboard side going in.

Entrance gas buoy No. 2 is moored in 6½ fathoms of water on the alignment of Dead island beacons with the southern tree on Bustard islands in one with Bustard Rocks Main light, and is 1½ miles S. 33 deg. W. true (S. W. ⅜ S. mag.) from South East rock, Gull rocks.

Approximate position: Latitude 45 deg. 51 min. 09 sec. N., Longitude 80 deg. 52 min. 46 sec. W.

Directions.—From a point about 2 miles eastward of Flowerpot island lighthouse, with Cove island light house just in sight, steer N. 40 deg. E. true (N E. ¼ E. mag.) 44½ miles to entrance buoy No. 2, passing ½ mile northeastward of Bears Rump

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island and rather farther off Half Moon island.

The land bordering the northeastern corner of Georgian bay is very low with no prominent natural marks that can be picked up from a distance, and as the shoals extend about 5 miles out great vigilance will be necessary to pick up the buoy.

The entrance buoy is moored well clear of all shoals and may be approached with safety from all directions between west and south-southeast. The best time to make the land is after ten o'clock in the forenoon, when the sun lights up the shore and the white beacons. In thick weather or at night, when approaching the shore, get the lead going in good time and on no account shoal to less than 10 fathoms until some known mark appears.

After passing entrance gas buoy No. 2, keep Dead island beacons in line bearing N. 58 deg. E. true (N E. by E. ⅞ E. mag.) for 2.6 miles, passing on the port hand black spar buoy No. 3, distant 400 ft., and black spar buoy No. 5, distant 850 ft., and on the starboard hand red spar buoy No. 4, distant 1,600 ft., off Francis Smith shoal, and red spar buoy No. 6, distant 300 ft.

When the distance has been run red gas buoy No. 8 will be found close under the starboard bow and the helm must be immediately ported to swing closely round the buoy and bring the Keefer beacons in one, bearing S. 87 deg. E. true (E. by S. mag.). Almost on this range, and distant 1 1/10 miles from gas buoy No. 8, will be found red gas buoy No. 14, marking the end of the reach.

While on the Keefer range black spar buoys No. 9, distant 750 ft., No. 11, distant 180 ft., and No. 13, distant 210 ft., will be passed on the port hand, and red spar buoys No. 10, distant 300 ft., and No. 12, distant 225 ft., on the starboard hand.

At gas buoy No. 14 starboard the helm to clear the buoy by 50 ft., and bring Wedge island beacons in one, bearing N. 58 deg. 15 min. E. true (N E. by E. ⅞ E. mag.), keeping them exactly on for 1-6/10 miles, passing on the port hand black spar buoys No. 15, distant 150 ft., No. 17, distant 250 ft., No. 19, distant 250 ft., No. 21, distant 50 ft., and on the starboard hand red gas buoy No. 20, distant 75 ft., and red spar buoy No. 22, distant 500 ft.

Upon this Wedge island range, between red gas buoy No. 20 and black spar buoy No. 21, the channel will be found very narrow, and great care must be taken to be exactly on the range when passing the gas buoy and a little southeastward of it when passing buoy No. 21 to avoid the middle ground, which is covered with 12 ft. of water and trends parallel to the range for 200 pards.

After passing red spar buoy No. 22 a vessel may port her helm slightly, heading N. 67 deg. E. true (E N E. ⅝ E. E'ly mag.) for a group of three pine trees, and pass 150 ft. off red gas buoy No. 24, off the northern end of Mann island reef, bringing the Dokis island range beacons on astern, on a course S. 84 deg. 45 min. E. true (E S E. ¾ E. E'ly mag.). Keep this on for ¾ mile to the wharf. Great care must be exercised on this range because it is astern, the beacons are rather close together, and the channel is very narrow.

The black buoys passed on this range on the port hand are No. 23, off Wedge island reef, distant 100 ft., No. 27, distant 100 ft, and No. 29, the same distance; on the starboard hand are red gas buoy No. 24, distant 100 ft., red gas buoy No. 26, distant 50 ft., and red spar buoy No. 30, distant 200 ft.

At the wharf ample water will be found, but the channel is so narrow that local knowledge is desirable for turning about the outer end. The water along the northern side of the wharf is good for a length of 150 ft. and a width of 125 ft. Along the southern side 27 ft. may be found for a distance of 500 ft. from the outer end, but this lane of water is only 200 ft. wide, the southern limit being marked by red spar buoy No. 32.

Leaving the harbor.—When fast to the southern side of the wharf heading out, Dokis beacons will be seen in one bearing N. 84 deg. 45 min. W. true (W N W. ¾ W. W'ly mag.). Cast off and keep them exactly on for 1,400 yards or until red gas buoy No. 24, off Mann island reef, is reached. Starboard slowly, to bring red gas buoy No. 20 ahead and the rear Wedge beacon slightly open southeastward of the front one, so as not to get too close to the middle ground, marked at its southwestern end by black spar buoy No. 21. When red gas buoy No. 20 is reached, bring Wedge island beacons in one astern, heading S. 58 deg. 15 min. W. true (S W. by W. ⅞ W. mag.) for red gas buoy No. 14, at the junction of the Wedge and Keefer ranges. Give red gas buoy No. 14 a berth of 50 ft. on the port hand, and bring the Keefer beacons in one astern, heading N. 87 deg. W. true (W. by N. mag.) for red gas buoy No. 8. Steer this course for 1-1/10 miles to the last mentioned buoy; round it at a distance of 100 ft. and bring Dead island beacons in one, heading S. 58 deg. W. true (SW. by W. ⅞ W. mag.) for entrance gas buoy No. 2, distant 2-6/10 miles. (N. M. 36, 1908.)

PARSONS' STEAM TURBINE CO., LTD.

The annual report of this company just issued says:

During the past year the works have been principally employed in the completion of the turbine engines for H. M. battleship St. Vincent. The directors are pleased to report that the application of turbine machinery of Parsons' type in war vessels and in vessels of the mercantile marine continues to extend. The total horsepower of turbine engines delivered and under construction by the company and licensees, including the Continental sub-companies and licensees of Parsons' Foreign Patents Co., Ltd., amounts to over 3,000,000 H. P. since the commencement.

Since last report the United States Navy have entered into arrangements to manufacture turbine engines, for the battleship Florida in their navy yard at Brooklyn, and have also adopted turbines of Parsons' type for the greater part of their new construction. A combination of low-pressure turbines and reciprocating engines, fitted in the yacht Emerald, owned by Sir Christopher Furness, the Otaki, built by W. Denny & Brothers for the New Zealand Shipping Co., Ltd., and the Laurentic, built by Harland & Wolff, Ltd., for the White Star Line, have proved eminently satisfactory. The results obtained with the Otaki have led to the New Zealand Shipping Company placing an order with W. Denny & Brothers for a second vessel to be fitted with the combination system.

In view of the very large field open in tramp steamers, which at present is untouched by the turbine, the directors have instituted experiments to ascertain the most suitable arrangements for such vessels. They hope these may lead to a successful solution of the question. The steamer Vespasian has been purchased and particulars of steam and coal consumption under loaded conditions with the triple-expansion reciprocating engines of this vessel having been obtained, these engines are being taken out, and preparations made for installing turbine machinery as soon as it is completed.

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Shipping League of Baltimore.

A FORMAL organization of the Shipping League of Baltimore, which was projected on Oct. 13 at a dinner given by Bernard N. Baker, at the Maryland Club, was effected on Oct. 14 at a meeting of the executive committee in the Equitable building, Baltimore. Composing the committee are Mr. Baker, president of the league, Robert Ramsey, vice president, and Messrs. T. H. Bowles, Norman James, Waldo Newcomer, B. H. Griswold Jr. and Lynn R. Meekins. The sum of $15,000 was subscribed at Mr. Baker's dinner to carry on the work of the league.

"With 50 original members enrolled," said Mr. Baker, "we already have 50 names of persons who are anxious to join, while we are also fully provided with money. We shall not solicit either members or cash, but shall place the organization on such a plane that persons will esteem it an honor to be on its rolls.

"Briefly stated, we are going to take a foremost position in whatever is done to build up American shipping, with the support of the administration at Washington. The main thing is to arouse every member of Congress in the South to the importance of developing the ports of the South."

Declaration of Principles.

The declaration of principles of the Shipping League of Baltimore reads as follows:

"The Shipping League of Baltimore is organized to discover, investigate and utilize the opportunities for this port that may be found in the building of the Panama Canal, the opening of South America, the progress of the far East, the development of ocean commerce and any legislation of the American Congress pertaining to the same.

"We are stimulated by the thought that less than a hundred years ago, and for many years after, Baltimore stood first in the fortunes of the seas and much of her wealth was founded upon the great work of her fleets. The influence upon the city was of incalculable benefit. In the 20 years' reign of the Baltimore clipper ship the population of Baltimore increased 240 per cent and its wealth more than 300 per cent.

"With the coming 20 years the field will be vastly widened. Our secretary of state has recently placed before us the facts of South America. In the statistics of growth in travel and trade, particularly between the Latin-American countries and our own, he shows that travel increased 50 per cent during the preceding year, our Latin-American trade enlarged from $261,000,000 in 1897 to $596,000,000 in 1907, or 128 per cent, and our exports to Latin-America from $76,000,000 in 1897 to $256,000,000 in 1907, or 237 per cent. Baltimore realized none of this increase; in fact, lost.

"Ought to Have More Trade."

"But even with this the share of the United States in the South American trade is only 13.8 per cent, while the vast bulk goes to England, Germany and Japan. We have only 8 per cent of the trade of China, where we ought to have 40 per cent, and our Chinese exports are only 9 per cent.

"Increases of 128 per cent and 237 per cent in South America are magnificent, but they fall short of the possible, and even in these figures we find that Baltimore is not securing any part. It is easily calculable that Baltimore, with the Panama Canal completed, may enjoy a South American commerce worth many millions a year. Moreover, the northern Pacific coast and its wonderful cities mean millions more for Baltimore's trade.

"Draw lines and one will find that Baltimore is 1,000 miles nearer than London and 1,300 miles nearer than Hamburg to the South American trade, particularly to the west coast, by way of the Panama Canal, and yet these two ports are getting tens of millions of dollars' worth of this trade, while Baltimore has only a few hundred thousands.

"Today six lines of railway are being built across South America. They mean new business of the largest value—business that Baltimore may reach.

"Our expectation is that Congress will pass a bill for the encouragement of the building up of our merchant marine at its coming session. We are now paying $300,000,000 a year to England and Germany for carrying our commerce. The diversion of any considerable part of this sum to the United States will mean work for all our shipyards and larger prosperity for all our harbors. Baltimore knew its liveliest age when its ships swept all the seas. Baltimore will know another great advance when it profits by the new conditions that will follow a real merchant marine and the completion of the Panama Canal.

"The Shipping League has at present no financial plan to promote. Its purpose is to find out and suggest the best way for Baltimore to take advantage of the great world development that is now reaching such gigantic proportions and which is bringing an entire change in the relations of nations, ports and men.

"With her new docks, her new channel, her nearness to the North and West, her unequaled position as a distributing point and her many natural facilities, we believe that no port on the Atlantic coast offers so many possibilities as does Baltimore, and it is to realize these that the Shipping League begins its work."

Merchant Marine League of San Francisco.

AT a dinner given in honor of John A. Penton, secretary of the Merchant Marine League of the United States, at the Fairmount hotel, San Francisco, Nov. 1, the Merchant Marine League of San Francisco was formed. About 200 men representative of the mercantile and commercial life of San Francisco were present. Governor Gillett of California acted as toastmaster. With him at the speakers' table were Senator George C. Perkins, Henry T. Scott, John P. Irish, R. P. Schwerin, George Knight, M. H. de Young, Congressman E. A. Hayes, Col. George Pippy, George W. Dickie, Harrie Weinstock and John A. Penton. Speeches were made by Senator Perkins, Mr. Irish, Mr. Schwerin, Mr. Weinstock, Mr. Dickie, Mr. Scott, Mr. Penton making the closing address.

At the close of Mr. Penton's address Capt. Hibbard proposed that the Merchant Marine League of San Francisco be formed and his motion was unanimously carried. The chair then appointed Capt. Hibbard, W. S. Webster, W. J. Dutton, John S. Rothchild and John F. Fraser as a committee to form a plan of organization. Later in the evening the committee submitted a form of constitution and a list of officers who were elected by a rising vote

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as follows: President, Frank B. Anderson; first vice president, R. P. Schwerin; second vice president, Capt. John Barneson; third vice president, C. C. Moore; secretary, C. C. Henion; executive committee: George W. Dickie, James McNab, Fred C. Parker, Andrew Carrigan, F. W. Van Sicklen, J. A. McGregor and James Rolph Jr.

LAKE FREIGHTER ON THE ISHERWOOD SYSTEM.

For nearly a year past Harry Coulby, president and general manager of the Pittsburg Steamship Co., has been considering the advisability of building a bulk freighter upon the Isherwood system of longitudinal construction. He has gone quite carefully into the matter and is impressed with its advantages over the transverse system. About two months or more ago J. W. Isherwood, the designer, visited Cleveland and submitted to Mr. Coulby the detail plans for a bulk freighter to be constructed after his design. These plans were sent to Lloyds Society of London and, with slight modifications, approved. Lloyds adjudged the matter of sufficient importance to send C. Buchanan, assistant chief ship surveyor, to this country with the plans. He, together with James H. Mancor, Lloyds chief surveyor for the United States, spent two weeks during October on the great lakes in consultation with Mr. Coulby and the ship builders. Both Mr. Buchanan and Mr. Mancor recommend the longitudinal system highly, claiming for it the joint advantage of greater strength with less weight and consequently greater carrying capacity. In fact, Mr. Buchanan estimated that in a 600-footer 500 tons of material could be saved. Lloyds Society makes no secret of its desire to have a ship to survey on the great lakes and as Mr. Coulby is much impressed with the data submitted to him, an interesting announcement along this line may be expected.

The Isherwood system was described in THE MARINE REVIEW June 4, 1908. In this system of construction the familiar closely spaced transverse ribs are omitted and the transverse strength is obtained by fitting on the shell and deck plating a series of strong transverses at widely spaced intervals. These transverses extend completely around the sides, bottom and deck of the ship and are slotted to allow of longitudinal frames and beams being fitted continuously throughout the transverses. The new system enables the steamer to be built of greater strength than ordinarily, and at the same time the dead-weight carrying capacity is considerably increased, the construction is simplified and all parts are readily accessible, reducing maintenance repairs to a minimum and offering greater facility for damage repairs.

LAKE ORE SHIPMENTS.

The lake trade is enjoying a period of old-time prosperity. Not for several years have the closing months been marked with the scramble for tonnage that now exists. For the first time in two years the vessel owner does not have to leave his office to place his ships. The shippers are quite willing to do the calling. Ore rates have been restored to the basis of 1907, that is to say 75 cents from the head of the lakes, 70 cents from Marquette and 60 cents from Escanaba. The advance, however, has not made tonnage more plentiful as, in fact, nearly all available tonnage is tied up on contracts. The pleasing thing about the advance, however, from the vessel owners' standpoint is that it is likely to continue throughout 1910, when, as everyone admits, all ore records will be broken. In fact, had it not been for the anxiety of a few of the smaller vessel owners to get cargoes during the slump of 1908, the freight rate would not have been cut at all.

The month was marked by a series of most peculiar storms, embracing the whole chain of lakes and tieing up scores of the largest carriers in the rivers for nearly a week. Notwithstanding this delay, however, 6,625,801 tons of ore were moved and the 7,000,000-ton mark would easily have been passed had weather conditions been favorable. Following is the summary of ore shipments during October:

Port	Oct. 1907.	Oct. 1908.	Oct. 1909.
Escanaba	779,626	739,924	928,175
Marquette ...	359,662	306,622	528,195
Ashland	381,507	498,802	714,271
Superior	1,176,027	644,175	1,003,956
Duluth	2,502,256	1,730,447	2,002,861
Two Harbors	1,283,576	1,179,140	1,448,343
	6,482,654	5,099,110	6,625,801

Port	To Nov. 1, 1907.	To Nov. 1, 1908.	To Nov. 1, 1909.
Escanaba	5,253,043	2,746,116	4,930,971
Marquette ...	2,701,812	1,177,730	2,507,712
Ashland	3,103,838	2,019,948	3,136,275
Superior	6,747,945	2,903,619	5,747,454
Duluth	11,908,539	7,931,568	11,850,038
Two Harbors.	7,326,684	4,946,091	8,092,884
	37,041,861	21,730,072	36,255,334

The movement of ore during November will be heavy as shippers are making every effort to create a record. They are handicapped, however, by low stages of water, some of the larger carriers being 1,000 tons short in their cargoes.

At the solicitation of the trade, ore receipts at lower lake ports will hereafter be compiled monthly, not only for Lake Erie but for Lake Michigan as well, Lake Michigan having latterly become an important ore receiving lake. Following are the tables of receipts on both lakes for September and October.

LAKE ERIE PORTS.

	September.	October.
Buffalo	920,373	900,541
Conneaut	1,138,306	979,842
Erie	151,661	243,651
Ashtabula	1,489,368	1,292,889
Fairport	399,214	287,155
Cleveland	1,063,967	982,360
Lorain	460,272	433,681
Huron	49,785	43,689
Sandusky	3,079	8,009
Toledo	261,581	262,599
Detroit	28,801	18,492
	5,876,401	5,452,908

LAKE MICHIGAN PORTS.

	September.	October.
South Chicago, Ill.....	713,400	545,120
Fruitport, Mich.	9,474	6,804
Elk Rapids, Mich.....	21,310	17,508
Milwaukee, Wis.....	38,119	28,982
Indiana Harbor, Ind...	28,342	26,691
Gary, Ind.....	340,000	311,424
East Jordan, Mich.....	10,482	8,185
	1,161,127	944,714

Exact data relative to the loading of the steamer William E. Corey in 39 minutes at Two Harbors on Oct. 10, is now at hand. The cargo had all been arranged for before hand, 9,311 gross tons of Pioneer ore having been placed in 33 pockets of the new steel ore dock, these pockets corresponding to the 33 hatches of the steamer Corey, and the balance of 800 tons held in Summers ore cars over the pockets. The loading commenced at 2:17 p. m. and by 2:56 p. m. the 10,111 gross tons (mine weight) had been poured into her hold and the chutes raised to the dock. It required but 24 minutes to run the 9,311 tons of ore that the pockets contained and the remaining time of 15 minutes was required in dumping 800 tons, or 18 cars. It will be noted that the Corey did not have to shift.

CONTRACTS FOR LAKE SHIPS.

Lake ship yards have under contract 24 vessels for 1910 delivery, James C. Wallace, president of the American Ship Building Co., closing last week orders for four bulk freighters to be of the popular 9,000-ton class, being 524 ft. over all, 504 ft. keel, 54 ft. beam and 30 ft. deep. The names of the contracting parties are for the present withheld. This makes 15 vessels that the American Ship Building Co. has under order for next season's delivery, 11 being bulk freighters, two package freighters and two passenger boats. The Great Lakes Engineering Works has under order eight vessels, seven being bulk freighters and one package freighter. The Toledo Ship Building Co. is also building a bulk freighter.

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ANNUAL MEETING AMERICAN SHIP BUILDING CO.

The annual meeting of the American Ship Building Co. was held at Jersey City on Wednesday, Oct. 13. The financial statement as prepared by the Audit Company of America showed the balance on hand as of June 30, 1908, to be $6,098,574.22. In the annual statement as prepared by the treasurer of the company this balance was given as $6,012,557.14 but the note appended to the Audit Company's report explains the difference. It was expected in certain quarters that the common stockholders would make a concerted effort to secure some increase in the dividend on common, but no such effort was made.

Robert Logan resigned as general manager and R. B. Wallace was elected in his place. The financial statement follows:

ASSETS.

Cost of real estate, buildings, machinery and tools, patterns, pat ents, models, furniture, fixtures, etc., as per books	$17,220,248.57	
Additions for year ending June 30, 1909	83,894.22	
		$17,304,142.79
Sundry bonds and stocks at cost		904,900.00
Materials and supplies, market value		466 937.04
Accoun's and Notes Receivable:—		
Notes receivable	$ 1 967.747.94	
Accounts receivable	1.091 096.75	
Accrued on uncompleted contracts	941,382.49	
		$ 4,000,227.18
Cash		823,560.69
		$23,499,767.70

LIABILITIES.

Capital Stock:—		
Common	$ 7,600,000.00	
Preferred	7,900 000.00	
		$15,500,000.00
Notes and accounts payab'e		416,871.86
Reserves:—		
For maintenance	$ 500 000.00	
For insurance	181 967.04	
For dividends (payable July 15)	138,250.00	
For sundries (taxes, rents, liability insurance, expenses etc.)	239,026.34	
For contingent earnings on unfinished construc ion, 1908-9	100,000.00	
		$ 1 159,243.38
Earnings, including $200,000 contingent earnings on unfinished construction, 1907-8 (before deducting maintenance and depreciation)	$ 1,257,722.15	
Less:—		
Preferred dividends	$553,000.00	
Maintenance and depreciation	194,850.63	
Rebuilding docks, etc	184,793.29	
	932.643 92	
Surplus for the year	325.078.23	
*Balance, June 30, 1908	6 098,574.23	
Surplus, including working capital		$ 6,423,652.46
		$23 499,767.70

Note.—In addition to the foregoing there exists a contingent liability from the guarantee of first mortgage bonds on steamships built by the company, aggregating $1,733,000, and carrying interest.

*In the annual reports of the company, possible profit on construction completed shortly before end of each fiscal year, or nearing completion at that date, have not been included in that year's earnings, pending active operations of the steamers, possible claims or additional work. The Audit Company has included this profit. R. C. WETMORE, Treasurer.

ANNUAL MEETING GREAT LAKES ENGINEERING WORKS.

The annual meeting of the Great Lakes Engineering Works was held on Oct. 26. Officers were elected as follows: Antonio C. Pessano, president and general manager; George H. Russel, vice president; John R. Russel, vice president and treasurer; H. W. Hoyt, vice president and secretary. These, with Joseph Boyer, Henry Ledyard, William G. Mather, Ogden P. Letchworth and Robert E. Plumb, constitute the board of directors.

The general report was satisfactory to the stockholders. The financial statement shows the company to be in excellent condition. After deducting the recent cash dividend and setting aside a liberal amount for the reserve fund, the surplus for the year ending Aug. 31, 1909, was $1,014,861, with practically all accounts payable paid up and no bills payable. President Pessano attributes the result to the personnel and organization of the company, which he regards as exceptional.

Notice has been given of an increase in the capital stock of the company from $1,500,000 to $2,500,000. Of this sum $750,000 represents a transfer from the undivided surplus, being in the nature of a stock dividend to the stockholders. The balance of $250,000 remains in the treasury. None of the new treasury stock will be used to finance the new ship yard at Ashtabula, as that will be cared for by an issue of bonds.

AIDS TO NAVIGATION AT BAR POINT.

President Livingstone of the Lake Carriers' Association has sent out a notice of the change in the position of aids to navigation at Bar Point, as follows:

The Bar Point light vessel has been moved northward about 2,500 ft. to the junction of the Amherstburg and Livingstone channel. Between this point of the light vessel and the point where the channel divides into the east and west channel entering Lake Erie, the available channel will have at least a width of 80 ft. and 22 ft. depth. The west side of this channel will be marked by seven lighted black spar buoys and the east side by six lighted red spar buoys and one red gas buoy; also one lighted red spar buoy will mark the east side of the channel just north of the light vessel. Down-bound boats will keep the Bar Point light vessel and black spar buoys close aboard and enter Lake Erie via the channel west of the Detroit river lighthouse. Up-bound vessels will leave Lake Erie via the channel to the east side of the Detroit river lighthouse, and after passing the red gas buoy north of the lighthouse they will keep the red spar buoy close aboard. The changes indicated are necessary to prevent vessels grounding on obstructions thrown up by dredges while improving the area to the east of the red spar buoys. Charts showing the changed conditions have been sent out to masters and mates.

AKERS EMERGENCY STEAM STEERER.

On Oct. 13 a Detroit paper published the following item:

Buffeted about in a heavy sea on her way down the river enroute to Cleveland last night, the D. & C. steamer City of Cleveland broke her steering gear off Sandwich shortly after 11 o'clock. She came to anchor there and after about two hours put back to her dock here. On board the boat are several hundred Pittsburg rooters who are returning to their home city. Most of them had retired and were not awakened even after the boat put back to Detroit.

One can imagine how much buffeting a great steamer like the City of Cleveland would receive in the Detroit river. The item was entirely erroneous, as no derangement occurred in her steering apparatus. The trouble was with her forward rudder, someone having forgotten to adjust the pin. The City of Cleveland is fitted with the Akers emergency steam steerer and in common fairness to the Akers company, A. A. Schantz, general manager of the D. & C. line, sent a letter to them, of which the following is a copy:

"A Detroit paper, on Wednesday, Oct. 13, stated that the steamer City of Cleveland was delayed several hours on account of the steering gear being out of order. I desire to say that this is not the case, as the trouble was with her forward rudder, as the regular and the emergency gear furnished by your company has given first class satisfaction at all times. I give you this letter so that you may use it if you so desire."

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THE WILDEST STEAMBOAT RIDE ON RECORD.

It is safe to say that a simple announcement that on a given date a steamer would leave the boat landing at the foot of Niagara Falls for Lewiston would bring more people to Niagara than New York held during the recent Hudson-Fulton celebration, yet the account of the actual occurrence as printed in the Buffalo *Express* of June 7 and 8, 1861, is told in a few lines and the trip was probably witnessed by comparatively few people. THE MARINE REVIEW, in endeavoring to collect some information regarding the old Maid of the Mist and her spectacular trip through the tormented waters of the Whirlpool rapids discovered that those who performed the exploit had passed away. Knowing that the late Charles Eckliff of Detroit had been her engineer, the REVIEW solicited information from his son, Charles C. Eckliff, United States inspector of steam vessels, Grand Haven, Mich., who in turn suggested applying to H. G. Trout, Buffalo, who had been an old-time friend and shop-mate of his father. We take particular pleasure in reproducing Mr. Trout's letter herewith:

"In reply to your favor of the 16th, I would say that I have but a general remembrance of the steamer Maid of the Mist's thrilling trip from her landing on the American side of the gorge, just below the Falls, through the Whirlpool rapids and rapids of the lower river to Lewiston, N. Y., but through the courtesy of the Grosvenor Library I have secured the following information:

"'The Maid of the Mist had proven a failure as a passenger steamer at the foot of the Niagara Falls. Her owners had an offer for the boat if she could be delivered on Lake Ontario. A crew of three volunteered; the pilot, Noel R. Robinson, and an engineer and his fireman. On the morning of June 6, 1861, the lines were cast off and the little ship started on her stormy voyage. She arrived at Lewiston, minus her smoke stack, fifteen minutes after, but in that fifteen minutes, the pilot had aged fifty years.'

"The above is substance of articles printed in the Buffalo *Morning Express* on June 7 and 8, 1861.

"I well remember the first trip of the Maid of the Mist from the American landing just below the falls to the Canadian landing. On this trip there were present Vincent Bidwell, the pilot, H. O. Perry, the engine builder, and C. M. Farrar, of Farrar & Treffts, and myself, the machinists. We were all amateurs at navigation in those waters but the trip was made successfully."

Anyone who has watched and studied the Whirlpool rapids at close range can have nothing but unbounded admiration for the pluck of those who undertook the trip.

We have been unable to discover any particulars of the boat but she was probably even smaller than those which succeeded her.

The engineer as stated above was Charles Eckliff, who died in 1906. An interesting fact, not brought out by Mr. Trout, is that H. O. Perry was the senior member of the firm of Perry & Lay, who operated the shops which later, as the King Iron Works, passed to the possession of Mr. Trout and which the Trout company still operate. The name Maid of the Mist has been perpetuated in two subsequent steamers which are familiar to most tourists, one an American boat and the other a Canadian. Improved transportation facilities, greater population and consequent and increased travel have doubtless made their operation profitable where the first of the name failed.

COMMERCE OF SAULT CANALS.

The commerce through the canals at Sault Ste. Marie passed the 9,000,000-ton mark in October, almost equaling September's record. During October 9,127,240 tons passed thorugh the canals as against 9,227,192 tons for September. The Canadian canal moved a greater portion of east bound freight and the American canal the west bound. The American canal carried 4,619,993 tons and the Canadian canal 4,507,247 tons. The total movement through the canals to Nov. 1 was 48,166,688. Following is the summary:

EAST BOUND.

	To Nov. 1, 1908.	To Nov. 1, 1909.
Copper, net tons	75,708	94,230
Grain, other than wheat, bu.	24,825,027	26,311,621
Building stone, net tons.	1,019	1,674
Flour, bbls.	4,090,459	5,162,355
Iron ore, net tons	20,953,638	34,395,380
Iron, pig, net tons	15,696	30,663
Lumber, M. ft., B. M.	384,502	484,412
Wheat, bu.	66,018,755	69,048,988
Unclassified freight, net tons	84,227	128,797
Passengers, number	25,578	29,011

WEST BOUND.

Coal, anthracite, net tons	1,124,014	1,106,097
Coal, bituminous, net tons	7,310,721	7,210,733
Flour, bbls.	800	3,700
Grain, bu.	5,400	5,750
Manufactured iron, net tons	219,911	376,931
Iron ore, net tons	.....	15,573
Salt, barrels	467,777	531,065
Unclassified freight, net tons	617,130	771,169
Passengers, number	25,841	29,823

SUMMARY OF TOTAL MOVEMENT

East bound, net tons	24,734,614	38,606,780
West bound, net tons	9,341,730	9,559,908
Total	34,076,344	48,166,688

SOME NEW SCHERZER ROLLING LIFT BRIDGES.

With the resumption of improved financial conditions the railroad companies are inaugurating many improvements in roadway, especially double and multiple tracking to secure increased facilities, economy and safety for handling traffic. Among other improvements a number of obstructive center pier swing bridges are being replaced by modern Scherzer rolling lift bridges. One of the most prominent improvements of this nature is the removal of the single track center pier swing bridge of the Baltimore & Ohio railroad over the Cuyahoga river at Cleveland and its replacement by a double track Scherzer rolling lift bridge having a movable span of 200 ft. from center to center of bearings. This bridge will be the longest double track single leaf bascule bridge yet constructed. Last year a single track Scherzer rolling lift bridge having a movable span of 230 ft. was completed for the Baltimore & Ohio Railroad Co., replacing a center pier swing bridge on the west channel of the Cuyahoga river, effecting a great improvement for the interchange of traffic between the railroad company and the large modern vessels navigating this channel to the docks of the railroad company.

The Seaboard Air Line has recently completed a single track Scherzer rolling lift bridge having a movable span of 196 ft., across the navigable waterway to their new wharfs and docks at Tampa, Florida. Another Scherzer rolling lift bridge is being constructed by this railroad company across the Savannah river, replacing an obstructive center pier swing bridge.

The San Pedro, Los Angeles & Salt Lake railway have recently completed and placed into service a single track Scherzer rolling lift bridge across the San Gabriel river at San Pedro harbor, California, this being the longest span bascule bridge on the Pacific coast.

A Scherzer rolling lift bridge was recently selected and placed under contract for construction as the movable portion of a long causeway being built to connect Galveston with the mainland. The railroads using this bridge will be the Southern Pacific, the Santa Fe and the Gould systems, and the Galveston & Houston electric railway. This bridge is designed to also accommodate highway traffic. Other American orders for railroad and electric railway bridges are too numerous to mention here.

Among the prominent foreign orders are a bridge for the Buenos Ayres

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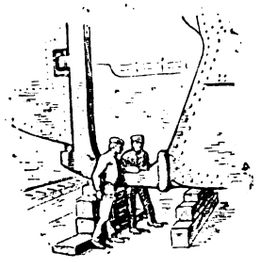

A UNIQUE ADVANTAGE IN WELDING BROKEN STERN-POSTS

is offered by the Thermit process, owing to the fact that a **re-inforcement of steel** is fused around the weld. This re-inforcement can be made as large as necessary so that the welded section will be as strong, if not stronger, than it was originally, thus guarding effectually against further breakage.

Another advantage of the Thermit process, and a most important one, is the fact that the welds can be made ANYWHERE. All appliances are light and portable and may be brought to the job. Sternposts and rudder frames of steam-ships are repaired in place at a tremendous saving over other methods. The same advantages apply in the repairing of gear wheels, crank shafts and other machine parts.

Write for Pamphlet No. 20-E which gives full information

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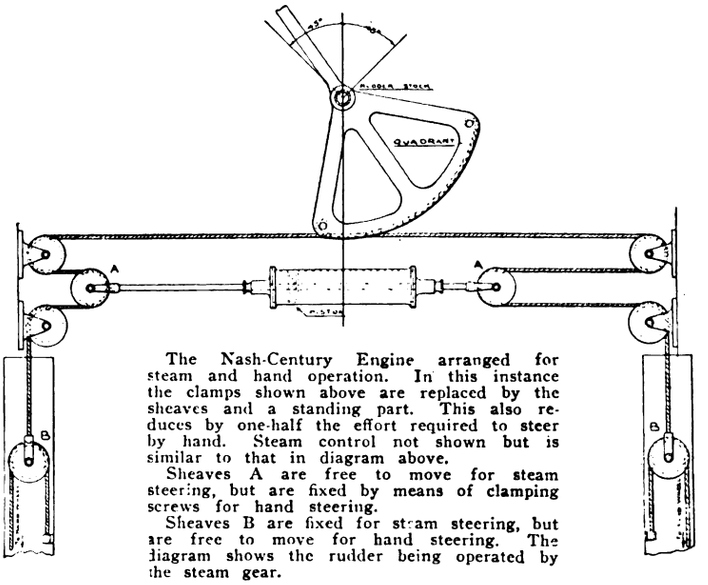
Great Southern railway to cross the Riachuelo river at Buenos Ayres, Argentina; an electric railway and highway bridge for the City of Dublin, Ireland; a bridge to cross the Lachine canal, Canada, for the use of the Canadian Pacific Railway.

The bridge at Buenos Ayres is the third order received from the Buenos Ayres Great Southern Railway, and is a result of the satisfactory completion and operation of the first double track bridge of the Scherzer type placed in service a short time ago. The traffic of this railway company is growing so rapidly that a second double track span for use in connection with the first structure is now needed. It has been manufactured in the bridge shops in England and will soon be erected at Buenos Ayres alongside of the present double track span, the two double track spans side by side forming one four track bridge to be operated jointly or separately as desired. The possibility of adding single, double or multiple track bridges to accommodate constantly increasing traffic is one of the advantages of the Scherzer rolling lift bridge as compared with the center pier swing bridge, which must be discarded, removed and replaced with a new bridge as soon as growing traffic requires additional tracks.

AN IMPROVED STEERING ENGINE.

The failure in the past of steering engines in which the movement of the tiller ropes was taken directly from a reciprocating piston instead of from a revolving drum has been due chiefly to their valve mechanism. Either the rudder movement was too abrupt or the rudder could not be maintained in the desired position satisfactorily. The Nash-Century steering engine which we illustrate is constructed with a novel valve movement by means of which these objections are said to be completely overcome. As will be noted, there is an absence of a multiplicity of wearing and power absorbing parts such as drum, spur and worm gears, large bearings, etc. The piston rod is prolonged equally through both ends of the steam cylinder and carries, at each end, a sheave, through which the tiller ropes and rove so that the quadrant travel is twice that of the piston. Steam pressure admitted at each end of the cylinder acts upon both sides of the piston, holding it in position and at all times balancing it against the pressure on the rudder.

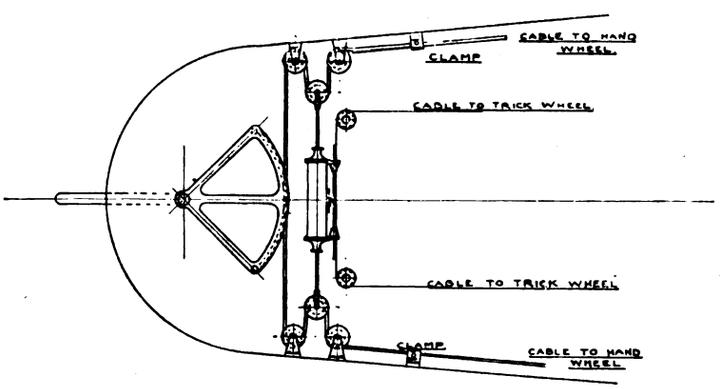
The valves which admit pressure to the cylinder are of the piston type and have a spindle common to both. When the controlling gear is stationary these valves are in mid position; that is, the valve rings cover the steam ports with slight overlap and prevent admission of steam to the cylinder. The movement of the steering wheel to port or starboard as desired, operates the control lever which, swinging about the floating fulcrum, transmits its pull to a connecting rod, the other end of which communicates with the valve spindle. The resulting movement of the valves uncovers the ports, admitting steam through the valve at one end of the cylinder and exhausting through the valve at the other end. The unbalanced cylinder pressure then shifts the piston and by means of the sheaves and cables attached to the ends of the piston rod the corresponding movement is imparted to the rudder.



The Nash-Century Engine arranged for steam and hand operation. In this instance the clamps shown above are replaced by the sheaves and a standing part. This also reduces by one-half the effort required to steer by hand. Steam control not shown but is similar to that in diagram above.

Sheaves A are free to move for steam steering, but are fixed by means of clamping screws for hand steering.

Sheaves B are fixed for steam steering, but are free to move for hand steering. The diagram shows the rudder being operated by the steam gear.



The Nash-Century Engine arranged for steam and hand operation. Cylinder placed athwartships. During steam operation both clamps on the hand wheel cable are set to prevent movement. If for steam operation only, the tiller ropes are made fast at A and B instead of passing through the third set of sheaves.

At the same time the movement of the piston causes the sprocket chain attached to the sheave blocks at each end of the piston to rotate the sprocket and its eccentric pinion. The sprocket and pinion are keyed to the same shaft and are practically one piece. The pinion meshes with an arc which swings about a center on a bracket on the cylinder casting. Extending from the center pivot of the arc and diametrically opposite to the toothed part is a projection which forms the fulcrum for the control lever. This explains why this fulcrum was previously referred to as "floating." The movement of the arc causes the fulcrum to travel in a radial direction and opposite to that taken by the valve spindle in opening for steam.

Thus the instant the piston has reached the desired position it has by its own action as transmitted through piston rods, chain, sprocket, pinion, arc, fulcrum and connecting rod, automatically closed the valve and shut off the steam. To keep the piston moving it is consequently nec-

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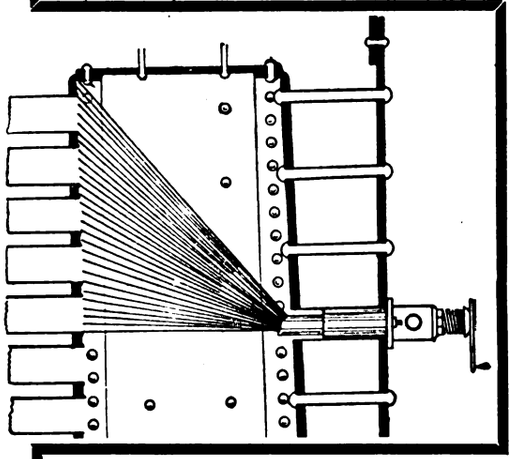

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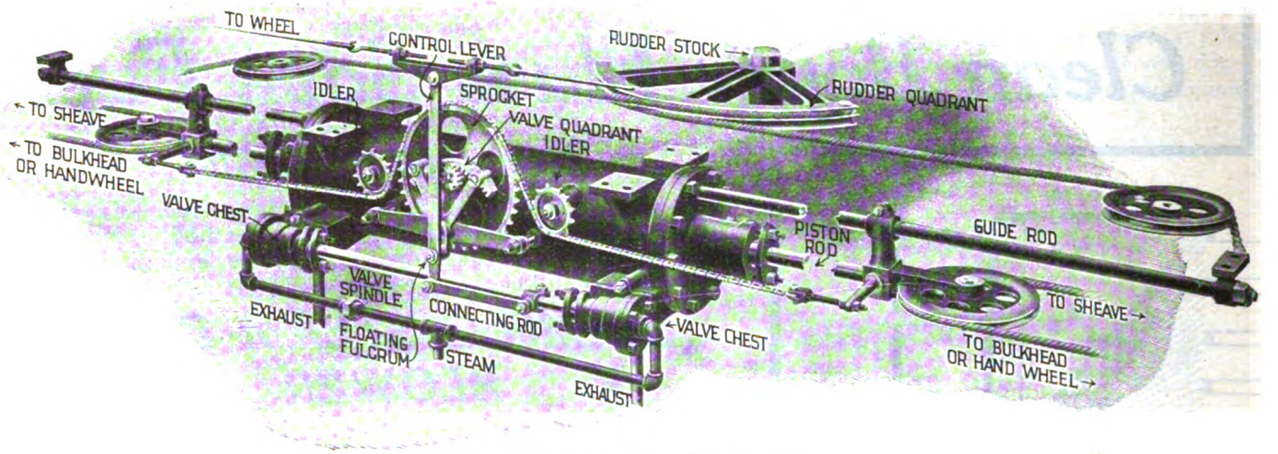


NASH CENTURY STEERING ENGINE.

essary to keep the control lever moving by operating the steering wheel.

In the event of undue strain upon the rudder, the Nash-Century engine instantly operates as a buffer. The action is just the reverse of that necessary for steering, but accomplishes the same purpose, that of keeping the rudder exactly where desired. The movement of the rudder forces the piston to travel; the travel of the piston opens the piston valve at the end of the cylinder towards which the piston is traveling, steam is thus admitted in proportion to the movement of the valve, and by the time the piston has been returned to its proper position the steam is again automatically cut off.

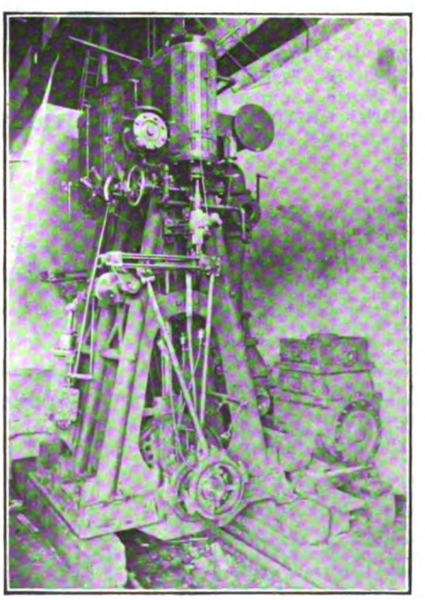
This gear is so sensitive that a movement of one spoke of the steering wheel will probably alter the course of the boat provided, of course, that all slack is eliminated. The action is perfectly noiseless, as the piston and other working parts move slowly, yet the rudder responds more quickly than with the usual indirect connection. The steam cushioning of the rudder is also claimed to be a great advantage, as it lessens danger from damage in heavy seas or from sudden impact with solid objects and does away with the necessity of spring-cushioning the quadrant. This yielding in the case of collision with the dock or from sudden undue pressure is just enough to ease the shock to the connections, pintles, etc.; hence, the wear and tear on these parts and danger of breakage is reduced.

The Nash-Century engine is intended as a "steam only" machine, but where desired provision may also be made for hand steering. The practical arrangement for both is shown in the second illustration. During steam operation both clamps on the hand wheel cable are set to prevent movement of the latter. If for steam operation sheaves on the ends of the piston rod are made fast by similar clamps. In the arrangement shown the cylinder is placed athwartships, which is the usual location. If desired, however, the engine may be placed fore and aft, or at an angle to the quadrant. The cylinder may be mounted upon the deck, swung from underneath deck beams, or mounted upon a bulkhead.

Information as to sizes, duty, etc., may be obtained from the manufacturers, the Century Engineering Co., of Ogdensburg, N. Y.

MONTAGUE IRON WORKS

The Montague Iron Works, Montague, Mich., is building up an enviable reputation in the lake trade. They manufacture all kinds of marine engines, independent pumps and condensers, propeller wheels and tow posts. Special attention is given by the firm to the compounding of high pressure engines. Herewith is published a photograph of one of the company's 16 and 34 by 26 in. fore and aft compound engines.



MONTAGUE COMPOUND ENGINE.

ORDER FOR PINTSCH GAS BUOYS.

The Safety Car Heating & Lighting Co., 2 Rector street, New York, has just closed contract with the United States Lighthouse Board for furnishing 18 B-III Pintsch gas buoys complete with lanterns and 20 additional Pintsch gas buoys. This order is another evidence of the popularity of the Pintsch system for lighting harbors and rivers.

The entire 38 lanterns are to be supplied with the invertable incandescent mantle which has proved so successful in service, many times increasing the projecting power of the lanterns heretofore used.

The September issue of W. & N. *Telephone Wire News*, published by the American Steel & Wire Co., is an interesting number. The leading article is upon the subject of the making of telephone wire, by J. F. Tinsley, electrical engineer of the company at Wooster. An interesting article is also published on types of insulators, with illustrations. Two pages are devoted to the various mills of the American Steel & Wire Co. in various parts of the country. The number is interesting throughout.

The sixth convention of the National Rivers and Harbors Congress will be held in Washington, on Dec. 8, 9 and 10. The opening address will be delivered by President Taft.

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